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Original Articles

MORPHOLOGIES OF MOUTH AND MOUTH BEHAVIOR

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DEVELOPMENT is an integrating concept. It tends to resolve the dualisms of heredity versus environment, of organism and culture, mind and body, structure and function. It also broadens our outlook upon morphology as the science of form. When Goethe coined the word *Morphologie* he was thinking of the shapes of skulls and flowers. The word still carries a physical connotation; but it cannot any longer be confined to physical structures. Child development and orthodontics, both in theory and practice, have a common interest in problems of form.

Form has been called the fundamental riddle. It is a ubiquitous riddle. It confronts us everywhere; not only in the shapes of the maxilla and the mandible, but in the very movements of the jaws. Form is the shape of anything as distinguished from the substance of that thing. In this sense movements have shape. Behavior has shape. Behavior grows. As it grows it assumes pattern, just as a bone assumes pattern. And just as bones and teeth have characteristic forms, so do patterns of behavior.

"Structure is only the intimate expression of function" was a leading maxim of John Hunter. In a monistic (but not mystic) sense "the mind" may be regarded as a living, growing "structure," even though it lacks corporeal tangibility. It is a complex, organizing action system which manifests itself in characteristic forms of behavior—in patterns of posture, locomotion, prehension, manipulation, perception, communication and social response. The action systems of embryo, fetus, infant, and child undergo pattern changes which are so sequential that we may be certain that the patterning process is governed

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by mechanisms of form regulation—the same mechanisms which are being established by experimental embryology and the physiology of development.

What Bunyan called the Mouth Gate of the City of Man-Soul may be considered from two points of view—the osseous and the kinetic, the anatomic and the dynamic. I shall venture to speak now and then almost in the same breath of bones and behavior. In a sense there are two morphologies, that of the myoskeletal system and that of the action system; but they are closely related and subject to similar morphogenetic mechanisms.

In our researches at the Yale Clinic, we have approached the problems of child development from the standpoint of developmental morphology. We have used the motion picture camera to chart the progressions of behavior patterning from birth, at lunar month intervals throughout the first year and then at longer intervals through the fifth year.[1]

THE PATTERNING OF BEHAVIOR

What is meant by a *behavior pattern?* Simply a defined, formed response of the neuromotor system to a specific situation. A young infant clasps a little cube placed in his hand—that is a behavior pattern. An older infant grasps a cube on sight—this is a more mature pattern. He mouths the cube, withdraws it for inspection, restores it to his mouth—another pattern. He gives the cube to the examiner on request; he builds a tower of three cubes; he counts three cubes. These are examples of patterned behavior. Growth is a patterning process, which molds alike the shapes of bones and of behavior.

The accompanying chart (Fig. 1) gives a bird's-eye view of the scope of behavior development in the first five years of life, including the fetal period, which is part of the growth cycle.

The organization of behavior begins long before birth. The general direction of this organization is from head to foot, from proximal to distal segments. The mouth takes something of a lead, eye muscles follow, then neck, shoulders, arms, hands, fingers, trunk, legs, feet. The chart reflects this law of developmental direction; it also pictures four distinguishable but inseparably related fields of behavior, namely: (1) Motor Behavior, (2) Adaptive Behavior, (3) Language Behavior, (4) Personal-Social Behavior.[2]

(1) Motor characteristics include postural reactions, prehension, locomotion, general bodily coordination, and specific motor skills.

(2) Adaptive behavior is a convenient category for those varied adjustments, perceptual, orientational, manual, and verbal, which reflect the child's capacity to initiate new experience and to profit by past experience. This adaptivity includes alertness, intelligence, and various forms of constructiveness and exploitation.

(3) Language embraces all behavior which has to do with soliloquy, dramatic expression, communication, and comprehension.

(4) Personal-social behavior embraces the child's personal reactions to other persons and to the impacts of culture; his adjustments to domestic life, to property, to social groups, and community conventions.

In terse terms the trends of behavior development are as follows:

In the *first quarter* (4 to 16 weeks) of the first year the infant gains control of his twelve oculomotor muscles.

In the *second quarter* (16 to 28 weeks) he comes into command of the muscles which support his head and move his arms. He reaches out for things.

In the *third quarter* (28 to 40 weeks) he gains command of his trunk and hands. He sits. He grasps, transfers, manipulates and mouths objects.

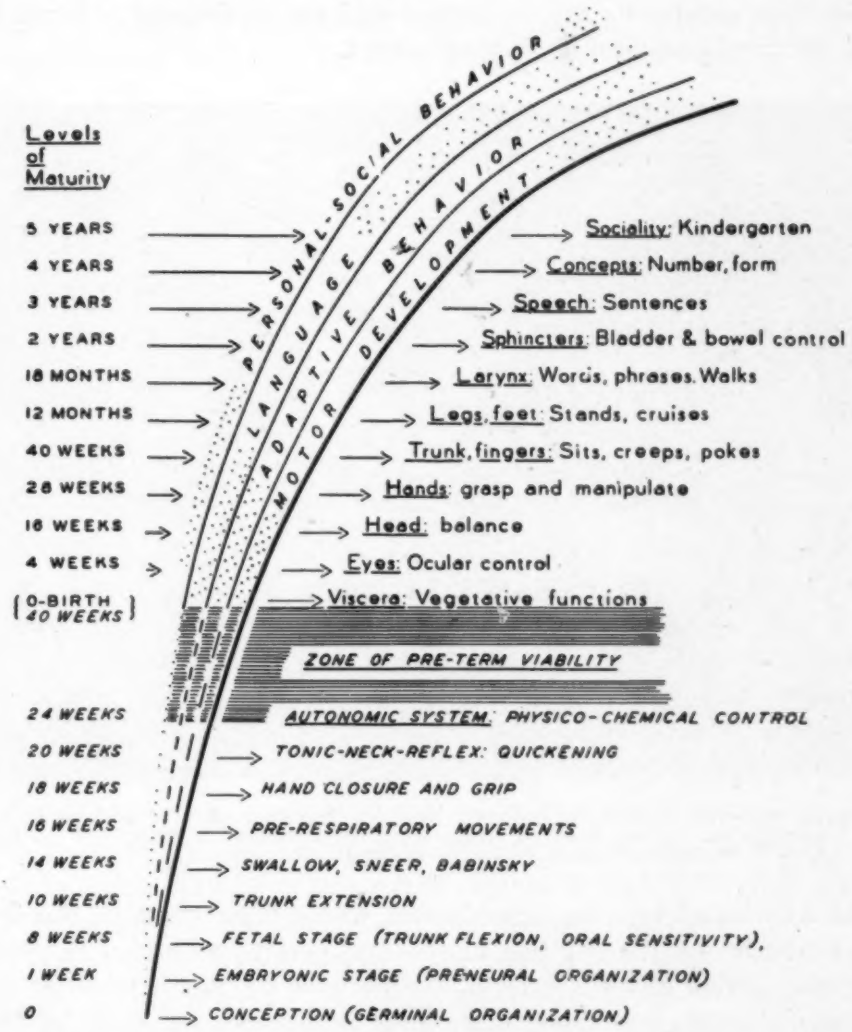


Fig. 1.—Chart showing scope and sequences of prenatal and postnatal behavior development. (From Gesell and Amatruda: *Developmental Diagnosis*, Paul B. Hoeber, Inc.)

In the *fourth quarter* (40 to 52 weeks) he extends command to his legs and feet; to his forefinger and thumb. He pokes and plucks. He stands upright.

In the *second year* he walks and runs; articulates words and phrases; masticates; acquires bowel and bladder control; attains a rudimentary sense of personal identity and of personal possession.

In the *third year* he speaks in sentences, using words as tools of thought. He shows a positive propensity to understand his environment and to comply with cultural demands. He is no longer a "mere" infant.

In the *fourth year* he asks innumerable questions, perceives analogies, displays an active tendency to conceptualize and generalize. He is nearly self-dependent in routines of home life.

At *five* he is well matured in motor control. He hops and skips. He talks without infantile articulation. He can narrate a long tale. He prefers associative play; he feels socialized pride in clothes and accomplishment. He is a self-assured, conforming citizen in his small world.

Fig. 2.—Behavior patterns of Twins T and C: Overhead view of prehensory approach upon a 7 mm. pellet. Note the mirror imaging of the behavior patterns; also of the crown whorls. (Twin T clockwise; Twin C counterclockwise.)

The amount of behavior organization which takes place in the first five years of life, before the eruption of the first permanent molar, is prodigious. During this period of swift growth, the patterns of mouth behavior undergo progressive changes, which may have some significance for orthodontics. Before we inquire into these changes, let us examine a little more closely how the morphogenetic forces work both with the hard tissues of bone and the softer tissues of "gristle" and of reaction systems.

The precision of morphogenetic mathematics is most beautifully demonstrated by the remarkable correspondences displayed in the behavior development of highly identical twins (Fig. 2). Twins T and C have been under our systematic observation for a period of fourteen years. Since early infancy there has been an amazing degree of concordance in the emergence and the configuration of their patterns of behavior. These patterns have been as much

alike as the patterns of their fingerprints and of their hair whorls. Mirror-symmetry is reflected in the patterns of pellet prehension pictured in Fig. 2. At 38 weeks the twins addressed a pellet with a fanlike spread of all the digits, the thumb extended at a right angle. At 40 weeks they made a raking approach; at 42 weeks they poked the pellet with the tip of the index. These changes in prehensory patterns took place synchronously and endogenously. Comparative studies of the behavior of Twins T and C by the method of co-twin control have shown that the endogenous mechanisms are so firmly entrenched that they can scarcely be transcended by training. All learning and conditioning are limited by a maturational substrate built up through the architectonics of intrinsic growth.[3]

THE PATTERNING OF STRUCTURE

Note also that the hair whorls are mirror imaged. The crown whorl of Twin T is clockwise, that of Twin C is counterclockwise. There can be no doubt that these twins were monozygotic in origin. Even the histologic characteristics of their hair show virtual identity. Microscopic examination of the hair at 42 weeks and again at 13 years showed a high degree of similarity in all particulars, including diameter, cuticle, medullary structure, tip and root, color and disposition of pigment. Doubtless, a comparable examination of tooth structure would have demonstrated an equal degree of similarity.

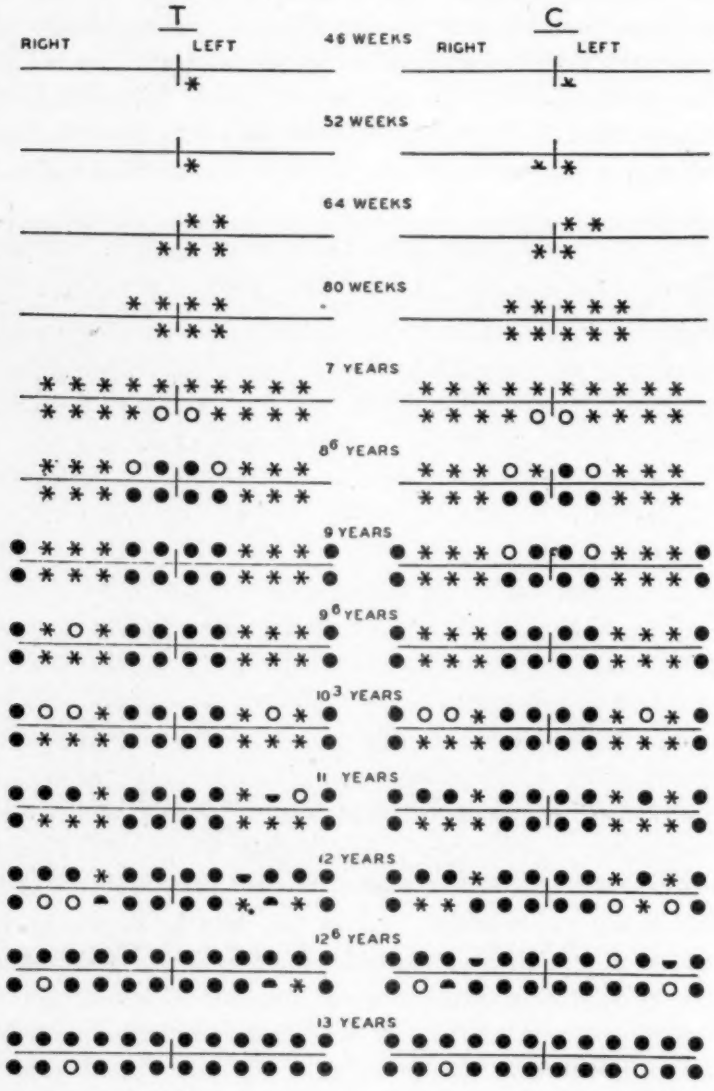
A comparative chart (Fig. 3) of the dentition of Twins T and C from 46 weeks to 13 years of age, shows a remarkable correspondence, and also a few small but consistent differences. The lower jaw of T is slightly more receding, although in general appearance the twins are virtually indistinguishable.[4]

Fig. 4 shows the dentures of another pair of twins who were amazingly alike in the morphology of their behavior patterns at the age of 8 years. They must have had an almost identical constitution to produce a contemporaneous delay in the eruption of the right upper incisor (1 and 2), to say nothing of a tiny pigmented mole near the left corner of each mouth.[5]

The kind of exception which proves the rule is shown in Fig. 5 which pictures a cast of the palate and upper teeth of a mentally defective boy. This boy presented the very rare developmental anomaly of hemihypertrophy, a unilateral enlargement of one half of his body which involved both soft and hard tissues, including the teeth. Measurement of the upper teeth showed a discrepancy in the size of the teeth. The right upper canine was 1 mm. wider than the left. It shared in the unilateral hypertrophy of the right side. In another instance the developmental disparity was so great that there were 8 teeth on the hypertrophic side with none erupted on the normal side. Hemi-hypertrophy represents an incipient and imperfect form of twinning which produces abnormal asymmetry.[6]

Perfect monozygotic twinning on the other hand produces equal and symmetric structures. Charles B. Davenport has reported the details of the growth process of the long bones of the palm of the hand and fingers. This process involves absorption of margins left behind the head of the bone and reconstruction of this part of the bone into part of the column. It is a self-sculpturing

process. "The resculpturing of the ends of the bones is beautifully and accurately done so that ordinarily no trace of the old head appears in the elongating shaft. In identical twins the sculpturing is done so accurately that exceedingly similar outlines of the bones of the hands result."[7]



COMPARATIVE CHART OF DENTITION FROM 46 WEEKS TO 13 YEARS OF AGE
Key: *=deciduous tooth.
0=tooth out.
●=permanent tooth.
◒=tooth partly erupted.

Fig. 3.—Comparative chart of dentition from 46 weeks to 13 years of age.

Fig. 6 pictures the eye grounds of the four eyes of another pair of twins who showed extensive resemblance in psychologic characteristics and abilities. Here is a beautiful instance of bilateral macular coloboma. The remarkable similarity of this defect in the choroid of the four eyes (virtual duplication of

size, outline, position, and pigmentation) shows with what deadly precision the processes of morphogenesis work in the embryonic period.[8]

Hybridization is in a sense the very opposite of monozygotic twinning. It is not a duplication, but an intermixing of two strains into a single one. But the resulting singleton betrays its duplex origin; both in the somatic and the psychic manifestations of form. The late Dr. Charles R. Stockard demonstrated this fact before his work came to an untimely end. The title of his posthumous monograph reflects his broad approach upon problems of developmental morphology: "The Genetic and Endocrine Basis for Differences in Form and Behavior."[9]

Fig. 4.—Twins A and B at age 8: Showing correspondence in eruption of right upper incisor (*1* and *2*); and in location of tiny pigmented mole near left corner of mouth (*3* and *4*). (From Gesell: Mental and Physical Correspondence in Twins, *Scientific Monthly* **14**: 305, 1922.)

Fig. 5.—Palate and upper teeth of C. E., age 12½ years; a case of total hemi-hypertrophy associated with mental defect.

Believing that the skulls of no other mammalian species approached in variety the skulls of domestic breeds of dogs, Stockard established the Cornell Experimental Morphology Farm. He multiplied the already existing variety of breeds through amazing hybrids such as Pekingese and Saluki, and basset-hound and dachshund. He collected the crania of almost every variation and deviation, numbering about 1,000 pedigreed specimens. On the basis of this systematic work he proved that the canine constitution is multiplex in character, and that it is made up of numerous specific factors controlled by specific genes. Certain genes were shown to have a specific influence on the morphology of bones and even on the morphology of the dog's behavior. He found in breeding

the contrasted varieties such as bassethound and Saluki that a marked discrepancy was often produced between the maxilla and the mandible. There was a strange lack of relationship which suggested that there was one morphologic plan for the maxilla and another plan for the mandible. The importance of such constitutional factors in the production of dental malocclusion has been developed in detail by A. LeRoy Johnson.[10] Stockard himself, in commenting on the undershot and overshot conditions of his canine skulls, remarked: "These conditions in the child have been attributed to various causes such as thumb-

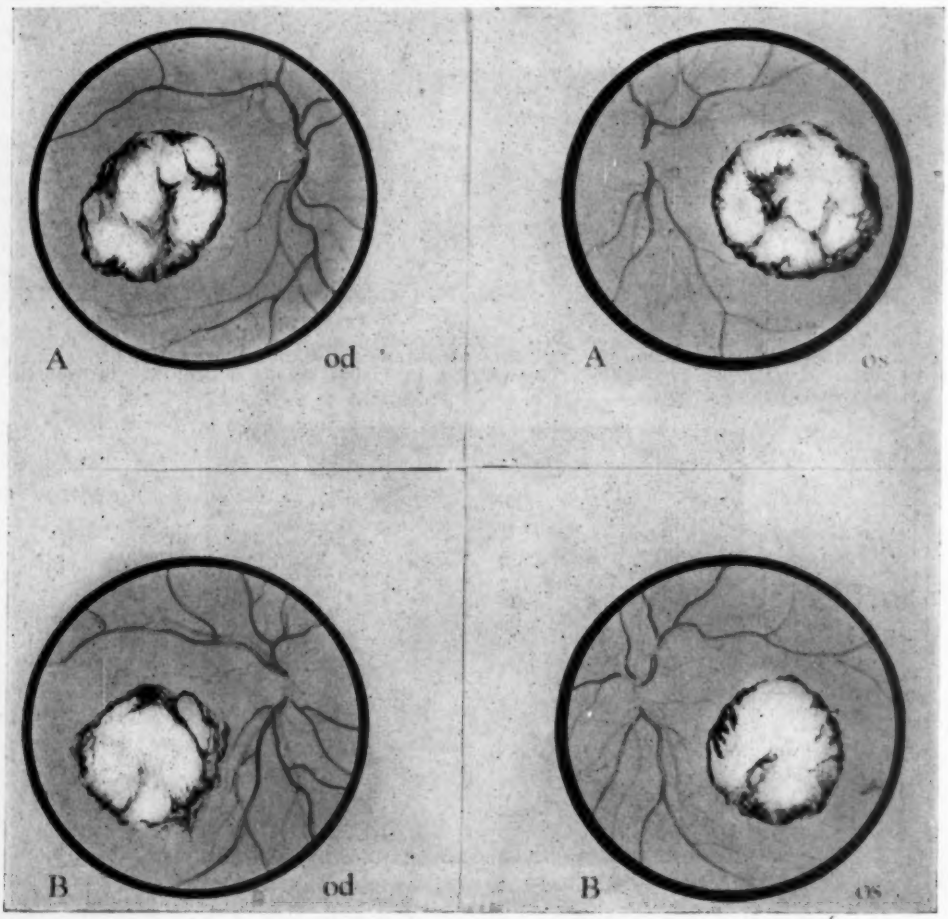


Fig. 6.—Right and left fundus of a pair of monozygotic twins, showing bilateral macular colobomas. (From Gesell and Blake: Twinning and Ocular Pathology, *Arch. Ophthalmol.* 15: 1050, 1936.)

sucking during babyhood, adenoidal interference with nasal breathing, etc. Certainly no such causes underlie the condition in the puppy and probably rarely do in the child. . . . The orthodontist in attempting to correct malocclusion continually finds that two patients with apparently similar kinds and degrees of malocclusion respond very differently to the same mechanical treatments."

These differences in response are evidently due to constitutional factors. There seem to be specific genetic determiners, one set for the upper jaw, one for the

lower, and one for the size of the teeth. There are similar specific determiners for certain patterns and modes of behavior. It is significant that even confirmed finger-sucking does not always have a permanent deforming effect. Deformities may be produced, but they usually undergo spontaneous correction if the sucking is not continued beyond the sixth year. The intrinsic determiners which lie at the basis of both somatic and behavioral forms tend to preserve the integrity of the organism and favor an optimal realization of growth potentialities.

In his hybrid litters, Stockard found assortments of temperamental and instinctive traits which indicate a well-defined hereditary determination. The general complexion of behavior in hybrid offspring tends to correlate with the shape of the cranium more than with body build. Take for example the cross between the Saluki hound and the bassethound. The Saluki is a tall, slender, streamlined, aristocratic creature who has come down through the ages (thanks to the stable genes) with a physical (and probably a psychologic) pattern quite similar to that of the domesticated dog portrayed by the ancient Egyptians. The bassethound is low flung, stocky, and short-legged. In temperament the bassethound is lethargic, the Saluki active. Saluki, on assuming a prone position, puts out his long forelegs with a graceful extensor thrust. Basset, when he settles down, folds his short forelegs inward with a flexor movement. And what do the strange-looking, short-legged, hybrid puppies do when they take a prone posture? In spite of the anatomic grotesqueness of it, they extend their short legs as though they belonged to the ancestral Pharaoh strain. In other words, the musculature of the basset-like extremities is controlled by the neurone mechanism of a Saluki type. This is evidence that a specific behavior pattern trend may be transmitted as an entity in spite of crossbreeding, the pattern preserving integrity even under the influence of an incongruent anatomic structure derived from an alien strain. Here maturation works with a vengeance.[11]

Whether we are concerned with bones or behavior, the fundamental determiners of form are intrinsic; they are endogenous rather than exogenous. Maturation is the term we apply to these endogenous factors. So-called environment does not generate the progressions of development. Environmental factors support, inflect, and specify, but they do not engender the basic forms and sequences of ontogenesis. The more we know about these sequences the better we shall understand the limitations and the possibilities of controlling human growth.

This principle of maturation certainly applies to the physical morphology of the mouth. It also applies to the morphology of the movements of the mouth. It is time to say something about patterns of mouth behavior.

CINEMANALYSIS OF MOUTH BEHAVIOR

All things considered, the mouth is a very versatile organ, capable of innumerable postures and activations—protrusive lips, extensible and retractible tongue, collapsible cheeks, compressive jaws, macerating molars (and negative pressure bellows)—all under the more or less voluntary control of a score of muscles. That control is primarily achieved by the slow and steady processes of maturation.

This complex and mobile mouth apparatus does not lend itself to easy observation. The mouth is often closed when we should like to see what is going on inside; and when it is open, it soon closes upon its objective. As an aid to our observation we have used the motion picture camera at the Yale Clinic, to capture the mouth in action. By cinema we have charted in a preliminary way the progressive stages of feeding behavior—breast and bottle, cup and spoon, soft and solid.[12] This has given us some idea of how the mouth gate works at advancing ages.

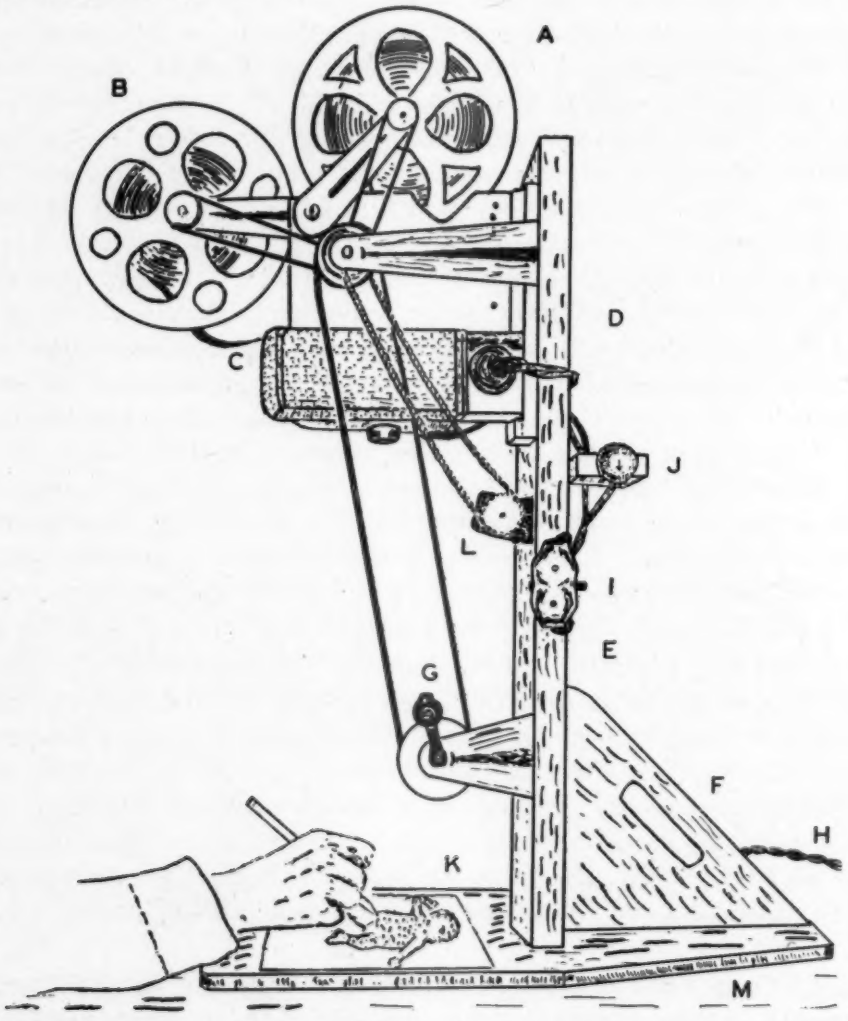


Fig. 7.—Analytic viewer for the morphogenetic study of cinema records of infant behavior.

The cinema does more than record the patterns of behavior. It provides us with a tool for studying these patterns as though they were morphologic entities. By means of a simple projection device pictured in Fig. 7 it is possible to freeze and to activate the movements at the observer's discretion. By such analysis he anatomizes the morphology of the behavior. He looks at the forms of movement with the same directness that a student analyzes the histology of tissue on a microscopic slide.[13]

The simplest apparatus for accomplishing cinemanalysis is an ordinary projector, mounted on a portable vertical stand, which rests on a desk or table (Fig. 7). In the model which we have developed at our clinic, the projector is operated by a small hand crank and throws an image 4 by 5¼ inches in size upon a white enameled plate. The operator sits at the table in comfortable and intimate relationship with the image which he controls by means of the crank.[1]

Let us assume that the projector carries a film which has recorded the prehension of a cube (a red, one-inch block) by a 28-week-old infant. The operator can project the record at a normal rate of sixteen frames a second. Time and time again he can witness the self-same behavior episodes, selecting first this, then that, aspect for intensive or repeated observation. By slowing the crank he can project at the rate of about two frames per second which renders the behavior in slowed but confluent motion. He may project at the rate of one frame per second and get a succession of intermittent stills. He can, of course, accelerate the rate and speed up the motion. He can always slow down to regain analytic grip on the data under observation. When that grip falters, he simply reverses the crank and inspects the sequence again. If necessary, he can look at the same sequence a hundred times.

Out of the multitude of frames which are under his observational control, he can select those phases of motion which most significantly express the configuration of the behavior. If he wishes to make a permanent record of these distinctive pattern phases, he simply takes a loose leaf from his notebook, places it on the white plate, and traces the image in outline. By thus tracing a well-selected series of such outlines, he inscribes in his notebook a faithful reconstruction of the original behavior. The cinema film has an infallible memory.

This study of the forms and the transformations of behavior can be made quantitative. The film "remembers" time and distance. Each frame represents a lapsed interval of $\frac{1}{16}$ or $\frac{1}{32}$ or $\frac{1}{64}$ second, depending on the speed of the camera. Each frame is automatically registered by a counter. By reading off the counter, by measuring distances and angles, it is possible to translate the patterns of behavior into time and space values.

The accompanying stilled photographs, taken from our cinema records of early feeding behavior, indicate that the development of mouth behavior patterns is much more complex than we are wont to suppose. The oral reflex which consists of a movement of the upper and lower lips is one of the very earliest, most constant and most definite reflexes of the fetus. At the fetal age of 14 weeks on tactile stimulation contraction of the orbicular, nasal and mouth muscles produces a unilateral "sneer," an elevation of the side of the upper lip and the ala of the nose (Hooker). At birth, sucking generally functions with a high degree of coordination, but it undergoes considerable improvement during the first month. At 8 weeks the infant opens his mouth wide and secures the nipple with relative ease; but in sucking, the central portion of the lips, particularly the upper lip, exerts the most pressure. The corners of the mouth are well approximated but not very active in sucking. An open gap separates the lateral portions of the lips. Although he does not poise his lips on the presentation of the first breast he makes this adaptive approach on the second breast even in his drowsiness. By 12 weeks of age he poises his lips on initial presentation as well.

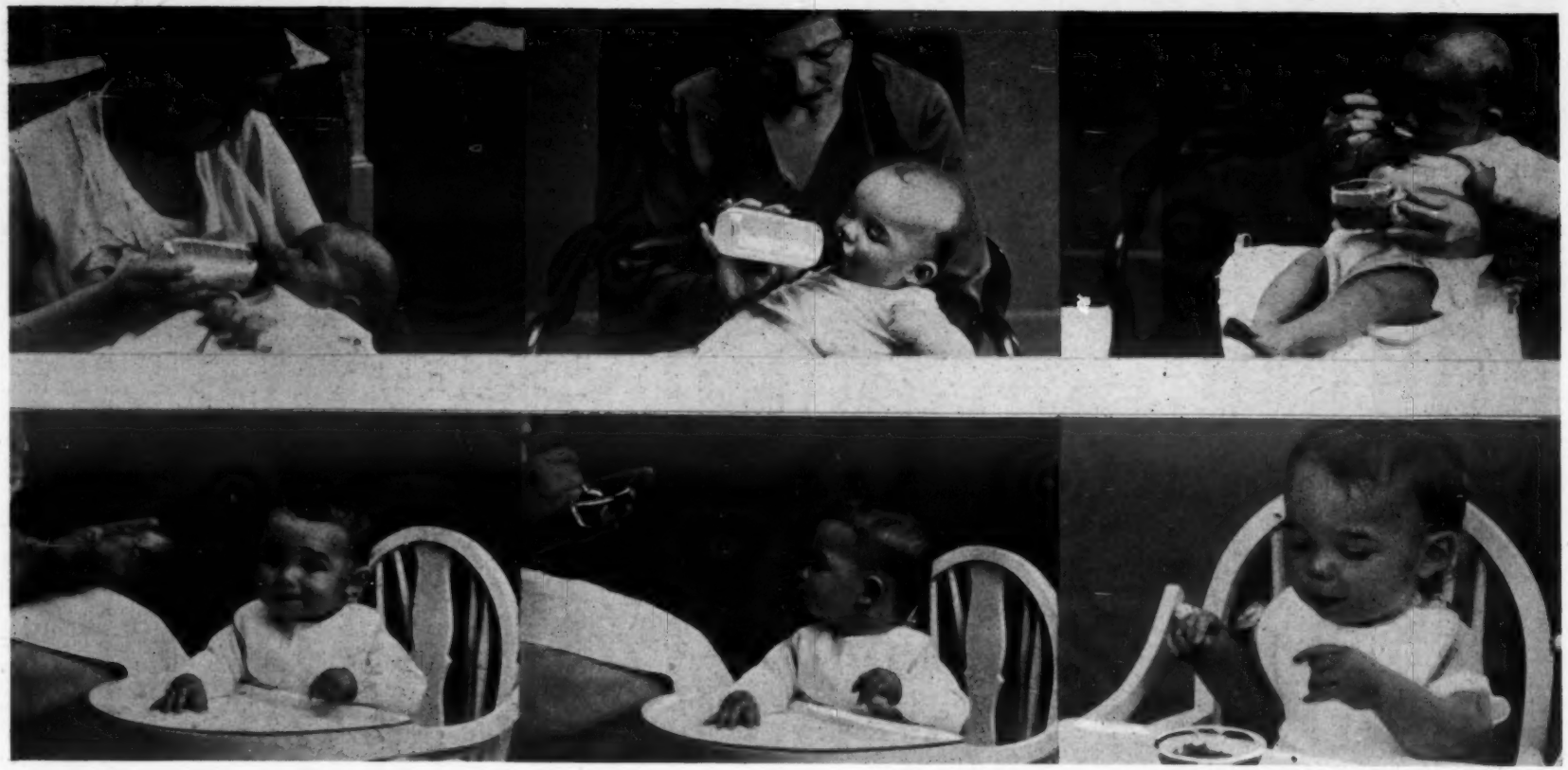


Fig. 8.—Oral behavior patterns; 12 weeks to 52 weeks. *A*, 12 wk.; *B*, 24 wk.; *C*, 24 wk.; *D*, 32 wk.; *E*, 32 wk.; *F*, 52 wk. (From Gesell and Ilg: *Feeding Behavior in Infants*, J. B. Lippincott Co.)

Fig. 9.—Oral behavior patterns; 64 weeks to 76 weeks. *A*, 64 wk.; *B*, 72 wk.; *C*, 76 wk.; *D*, 76 wk.; *E*, 76 wk.; *F*, 76 wk. (From Gesell and Ilg: *Feeding Behavior of Infants*, J. B. Lippincott Co.)

At 12 weeks of age the lateral lips participate in the closure upon the nipple, as shown by a dimpling of the upper lip (Fig. 8A). He extrudes his lips to surround the neck of the bottle better. The new lip flexibility manifests itself in a sputtering kind of lip play which brings delight to fond parents.

The lower lip continues its passive role until 20-24 weeks when its lateral aspects become active, causing the lips to purse together at the corners (*B*). It is at this age that the mother often reports that the infant smacks his lips or pouts them in play.

In connection with presentation of the spoon this poising response does not occur until 20-24 weeks of age (*C*). Spoon feeding becomes an easier task for the mother as the infant now automatically draws in his lower lip as the spoon is removed (*D*). He also pouts his lips in the process of shifting the food in his mouth and in swallowing (*E*). This increasing virtuosity leads soon to the complicated muscular act of chewing which becomes a more defined pattern after 44 weeks. The mastication of the infant is virtually toothless, but it involves several coordinated movements. The lower lip rolls out slightly (*F*).

Following this the lips separate, particularly if the food is in the anterior portion of the mouth. The corner of the chewing side of the mouth is drawn up and in. Not only the corner of the mouth but also the inner surface of the cheeks is drawn in at the alveolar margins. This muscular pull probably serves to milk the saliva down the parotid duct and aids the tongue in mixing the food with the saliva. On swallowing, the lips are closed tightly and both corners are drawn in and up.

The automatic drawing in of the lower lip after the spoon is removed now becomes a more selective process, occurring mostly when there is food on the lower lip. This reaction becomes more defined with age and at 15 months comes to include a drawing in of the upper lip (Fig. 9*A*). A further elaboration develops: the lower lip not only draws in to bring adherent food into the mouth cavity, but it sweeps over food on the upper lip (*B*).

At 18 months chewing assumes a more mature aspect. The mother often reports that the child is becoming fond of meat and chews it very well. The lip and jaw movements now suggest a wide rotary action of the first year molars. Comparing the earlier chewing in the last quarter of the first year with this 18-month chewing, the lateral expansion of flexibility of the lips is at once apparent. After the food is placed in the mouth, the following sequence of movements ensues: the lower lip rolls both out and to the left (*C*); the mouth then opens slightly with some pursing as the lower lip projects forward (*D*). As the food is drawn back into the mouth by the tongue, the mouth widens and draws in at the corners especially on the left (*E*). The lips now close, drawing the upper teeth over the lower lip, and contract at the corners (*F*). One can readily see from the photographs that to the 18-month-old child chewing is a complicated process, which requires effortful attention on his part. The 2-year-old child chews more automatically. By three years the patterns are comparatively mature.[12]

This in outline sketches some of the growth changes in mouth behavior which occur prior to the eruption of the school-entrance molars. It is probable that the developmental morphology of masticatory movements would repay more systematic study by the method of cinemanalysis. A clearer knowledge of the early developmental aspects of these movements should be of value in the supervision of treatment. It should also lead to earlier and more discriminating diagnosis. Is it not true that in orthodontics as in pediatrics the stress of preventive and corrective effort should be continually shifted toward the first years of life?

* * *

The nineteenth century is sometimes called Darwin's century. Darwin, through the concept of evolution, gave us a better understanding of the nature and the origin of man as a biologic species. The present century is pre-eminently concerned with man as an individual. If our democratic culture survives, the task of science and society will be to define the nature and status of the individual. The physiology of individual development has become a major problem of the life sciences. Medicine and hygiene will be called upon to apply the rapidly accumulating knowledge of the laws of growth.[14] Developmental morphology is destined to become a clinical science, directed toward the diagnosis and health supervision of all children. It will be an inclusive supervision embracing both bones and behavior, both the mouth and the movements of the mouth.

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14 Davenport Avenue

DISCUSSION

Dr. Richard H. Stucklen.—I should like to ask Dr. Gesell a few questions at this time. One is: In connection with this tonic neck reflex is there any indication as to the handedness

which the child is to develop? If it is extended toward the right is that an indication that the child will probably be right-handed, or if it is to the left that it will be left-handed?

The other question is: While I know Dr. Gesell did not have time to dwell on this, in the development of these reflexes and growth patterns how much variation would you ordinarily find among normal children?

Dr. Gesell.—To answer the last question first: of course variation is the law of nature, and individuality, as the outgoing President of the American Association for the Advancement of Science recently said, is one of the major subjects of science, whether in the earth sciences or in the life sciences. But these variations are about a norm. Take this matter of prone progression. Of course, we know children do not all go through these stages in just the same way, but I have never seen a child that really shortcircuits them. These stages are the species' characteristics, so that the shortest way to answer it is to say there is a species norm, and that that norm can be defined, and that there are variations about it, but that there are no miraculous or lawless deviations from that norm, otherwise we could not use these devices and these norms diagnostically.

We now use these norms; for example, prior to the adoption of infants. Infants are brought to us with the question: Is this child normal or defective? Does he have a normal developmental outlook from the standpoint of general mentality or not? By the application of these diagnostic procedures by clinically experienced persons, that question can be answered with considerable accuracy.

Things refuse to be too simple, so I cannot give a simple answer to the first question except to say that strongly left-handed children tend to show that they are left-handed by a left T.N.R. (tonic neck reflex). Likewise well-ingrained righthandedness shows itself in the same way, but there is an intermediate group where there is some ambiguity. As a matter of fact, the laterality question has been oversimplified. It is not simply a matter of handedness; it is a question of handedness, eyedness, footedness, etc. This is not a single unit character trait. But certainly some children have much more unilateral dominance than others. Some of our problem cases are those very cases in which there is a conflict or fluctuation in dominance.

Dr. Stucklen.—I wonder if Dr. Gesell would just remark a little bit about the variation in the time of these developmental patterns. That is what I was thinking of primarily. I was thinking more of the variation of the time of development of these various traits such as the building of the tower, the train, and the bridge.

Dr. Gesell.—There would be some variation, but you are not likely to find a 12-month-old infant building an 18-month tower. If he does it will also be done in a different way. I do not ever recall having seen a 12-month-old infant building an 18-month tower, nor have I ever seen an 18-month-old infant building a 3-year-old bridge. I have never seen a child that walked before he crept. Of course there are a few very special exceptions to prove the rule. You can put it this way: that if the ratio between the expected time of development and the actual time of development is as 2 is to 3, you are getting near the borderline of defect. There are only a small proportion of the children that show that degree of retardation. If the developmental ratio is less than 2/3 in all fields of development (not only in posture, but in prehension, manipulation, in adaptive behavior, language behavior, and personal-social behavior), if there is a general retardation in all of these fields, then the infant is in all probability mentally defective and not a fit subject for adoption. Birth injuries to the brain are relatively numerous. They may be mild, severe, or selective.

Our diagnostic problem is to determine from the infant's behavior, to what extent he is normal and in what respects he is permanently or curably handicapped. The maturity norms of behavior enable us to make a developmental diagnosis. Like any other diagnostic instrument, the norms must be used with clinical caution.

Dr. J. H. Sillman.—I noticed in the picture that you showed of the horizontal-vertical movements of the child with the blocks, that if the blocks had been small enough he would not have gone through many of those movements, but he would have stuck those blocks in his mouth. The reason he did not stick the blocks in his mouth was due to their size. That brings up this point: I am interested in the sucking and physiologic biting urge of the child, and I would like to know at what ages or when would you interfere with the child's

sucking and/or biting habits, or do you think there is any reason at all to interfere? Is that a normal physiologic process through which the child must go, at least between certain times?

Dr. Gesell.—I will be very brief and simply say in answer to the last question that Magnus demonstrated the fact that you could produce the tonic neck reflex in the rabbit. These laws of morphogenesis are so fundamental that they go back into the vertebrate phylum.

There is such a thing as physiologic biting; in fact, when the infant is in his thirties (in weeks) it is a very prominent reaction, and it is entirely normal. At sixteen weeks also you get a kind of sucking which is almost universal. The hands engage at the midline and come to the mouth because the child is under the joint compulsion of a closing-in and mouthing reaction. Therefore, for a brief period he tends to suck fist and hands. That is perfectly normal. Later on you get something else, but that is too long a story.

Dr. Lawrence W. Baker.—As Dr. Gesell showed those remarkable reflex patterns, I was strongly reminded of that film that I had here, a film in which the decerebrated animals had the same patterns all through and the decorticated animals the same patterns all through. Have you noticed that?

Dr. Gesell.—Yes.

Dr. Baker.—They go right through the same identical patterns. I will have to bring that film to you again. I think you will appreciate it more.

President Riesner.—Before we finish with this topic and go on to the next, I will give the courtesy of closing the discussion on your paper to the other member of the symposium, Dr. Salzmann.

Dr. J. A. Salzmann.—As I see it Dr. Gesell's paper has emphasized the viewpoint that I have tried to stress. There is an interrelationship of the genetic and environmental factors responsible for form and function. Furthermore, form and function themselves are in turn interrelated. In our consideration of the etiology of malocclusion, we must take into consideration these interrelationships.

Dr. Gesell.—I am sorry I did not hear Dr. Salzmann's paper. The Bankers' Express did not run this morning so I was one hour late, but I got that story about the horse. You sometimes have to shoot the horse if you don't indulge in some theory.

DIAGNOSIS IN ORTHODONTICS: THEORY AND PRACTICE

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INTRODUCTION

The truism that "An honest confession is good for the soul," has been a constant feature of orthodontic meetings. Time and again, some of the foremost men in orthodontics have come before us in the true spirit of the humble scientist to remind us how little we actually know about orthodontics. Their words of admonition have often acted as a balance wheel, checking our tendency to become overconfident of our practical accomplishments. Frequently other men in the field of cognate research and science have come before us bringing us their findings and correlations which have added to our enlightenment. On occasion, however, some of the so-called enlightening talks were found to solve no problems and only tended to render us more confused than ever. The reason for this confusion is that many a man has seen fit, knowingly or not, to present his contributions in a manner that, while creating the impression of profound erudition on the part of the speaker, severely detracted from the value of his contribution. Furthermore, there has been too much of a tendency for writers and speakers in orthodontics to clothe the obvious and well-known in terms of the mysterious.

There is an enormous lag at present between the science of orthodontics as it is recorded in our literature and the art of orthodontics as it is practiced in our offices. This being so, it seems to me that it is of importance for us to stop occasionally and take stock of the wealth that we possess in the form of accumulated scientific knowledge; to appraise this wealth; to consider whether or not we are benefiting by it, and, indeed, if it is usable wealth. In other words, it is just as important for us to correlate the facts that we already know as it is to learn new facts.

Gesell[11] has stated that: "The practicing pediatrician has three functions: diagnosis, therapy, and supervision, and the greatest of these is diagnosis." One might paraphrase his advice. The practicing orthodontist also has the same three functions: diagnosis, therapy, and supervision, and likewise, "the greatest of these is diagnosis."

BASIS OF ORTHODONTIC DIAGNOSIS

The term *diagnosis* may be defined as the determination of the nature of disease or deviation from the normal physical, functional or mental state. Therefore, a specific norm is a prerequisite of diagnosis. Various norms have been established with the aid of the basic sciences, such as anatomic, physiologic, biometric and other norms by means of which the measurement of the deviations from the normal state of man is effected.

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In orthodontics, diagnosis is of an anatomic or morphologic nature because dentofacial anomalies which concern the orthodontist are, in their final analysis, deviations from an accepted anatomic norm. These anatomic deviations may be pathognomonic of, concomitant with, or sequelae to certain local and general bodily disturbances of prenatal or postnatal origin, or both.

Throughout the years orthodontists have erroneously used the term *diagnosis* as a synonym for *classification* and *vice versa*. It is not my intention to question the validity of Angle's classification which has successfully withstood the test of time for over half a century. Nor, I believe, was it the intention of Hellman to criticize Angle's classification per se, when he recently called attention to the confusion resulting from Angle's[1] indiscriminate use of the term *diagnosis* when speaking of *classification*. Hellman himself, however, in his article on "Diagnosis in Orthodontic Practice"[14] fails to clarify the issue, especially when he states: "It did not matter much (whether orthodontists confuse diagnosis with classification) because the result was the same, insofar as the outcome of orthodontic treatment was concerned." Although the title of Hellman's paper is "Diagnosis in Orthodontic Practice,"[14] what he actually discusses there is the measurement of facial growth in relation to his designated stages of dental development which, while an important item in diagnostic procedure, is not all of diagnosis.

DIAGNOSTIC PROCEDURE IN ORTHODONTIC PRACTICE

The complete examination of the patient must, of course, precede any attempt at diagnosis. Examination may include any or all of the following procedures:

1. Written record:
   a. Medical history of patient's family.
   b. Medical history of the patient.
   c. Dental history of the patient.
2. Clinical dentofacial examination:
   a. Facial
   b. Dental
3. Biometric examination:
   a. Skeletal
   b. Cephalic
   c. Gnathostatic
4. Roentgenographic and photographic examination:
   a. Intraoral
   b. Extraoral
   c. Orthophoric*
   d. Skeletal, e.g., carpal

The family medical history is an aid in determining the presence of systemic disturbances, which may be of genetic, endocrine, nutritional or other origin. The family dental history should include a record of the condition of periodontal disease, marked caries and other oral diseases; the prevailing types of occlusion, abnormalities of tongue size; abnormalities of the lips, masticatory and facial muscles.

*Roentgenograms or photographs taken along the same parallel lines but at different intervals.

The medical history of the patient should include congenital and acquired defects, nutritional status, presence of infection, allergic manifestations, endocrine disturbances, and other diseases as well as accidental injuries. Posture and gait should be noted. Pillowing and other pressure habits during sleep should be ascertained, as well as the relative amounts of sleep, rest, and play.

The height and weight of the child at the time of the first examination and at subsequent re-examinations should be fitted into the individual's channel on Wetzel's[35] grid. Loss of weight may be due to malnutrition, tuberculosis, metabolic disturbances, general chronic infections, extensive dental caries or painful oral infections, nervous and emotional disturbances. To the contrary, excessive appetite or thirst may be due to gastrointestinal disturbances, diabetes mellitus, or fevers. The child should be followed according to his own normal rate of physical advancement rather than compared with averages of other children.

The clinical examination of the teeth should concern itself with the sequence of eruption, velocity of eruption, and the time of shedding of individual teeth, as well as the presence of infection in the teeth and gums. It should be determined whether the eruption pattern is in accordance with the general development and state of maturity of the individual child. The teeth should be examined while in occlusion; when the jaws are open, and when the mandible is going through its various excursive movements.

The dental examination which confines itself to the physical inspection of the teeth and the classification of the existing malocclusion, even when supplemented by dental roentgenograms and the usual plaster casts, cannot be considered a sufficient basis for determining the need for orthodontic treatment in the growing child.

The biometric examination, in the form of facial measurement, has value in the individual examination of the child only when considered in relation to one or more previous or subsequent examinations at stated intervals. The amount and rate of progress over a period of time are of significance in the diagnosis of growth. A single examination in a growing child is not a reliable method of determining the rate and direction of growth.

Measurements may be made on the face itself or on orthophoric* distance roentgenograms and on orthophoric* photographs. Direct measurements may be compared and a comparison of percentage increments may be made, or orthophoric roentgenograms may be traced and the tracings superimposed and the differences in proportions noted.

Ordinary dental casts are not alone adequate for diagnostic purposes in orthodontics for the following reasons:

1. Only the occlusal relation of the teeth is presented.

2. Lack of development cannot be shown in relation to adjacent landmarks of the head.

3. Asymmetry of the arches is not related to the head in the three planes of space.

4. The degree of angulation of the dentures or plane of occlusion is not represented in relation to a fixed plane.

*Orthophoric—along the same parallel lines.

Dental casts should present an exact portrayal of the details of the anatomy of the teeth, alveolar processes, alveolo-buccal folds, palate, attachments of muscles and frenums, as well as the relationship of the maxillary to the mandibular arch and their relationship to the cranium and face. Dental casts should also portray dentocranial deviations and abnormalities in height, width, and length of the denture and its growth in one or more of the three planes of space and of the angulation and inclination of the teeth in relation to the face and cranium.

It is not always necessary to use all of the diagnostic techniques available to the orthodontist for the practical purpose of establishing a diagnosis for planning treatment in each individual patient. This is especially true in the correction of positional deviations of individual teeth when sufficient space is present to bring them into occlusal alignment. Although the examination should be complete, it must at all times adhere to a practical basis. If no correlative systemic conditions are disclosed, the orthodontist should confine himself to the dental findings alone. Only such diagnostic methods should be followed as might be of value in treatment planning, the observance of precautionary measures, avoidance of contraindicated techniques and in obtaining a successful termination of treatment.

Diagnosis in orthodontics actually includes consideration of the following:

1. Etiologic factors responsible for the deviation from the accepted anatomic norm.

2. Classification of the anomaly according to the type or direction of deviation from the accepted dentofacial norm.

3. Correlation of etiology and classification with the maturative age of the patient, including bone age and nutritional status.

These three factors must be ascertained as accurately as possible in order to decide on the time, type, intensity, direction, and duration of treatment. We shall consider each item in this basic triology of diagnosis in turn.

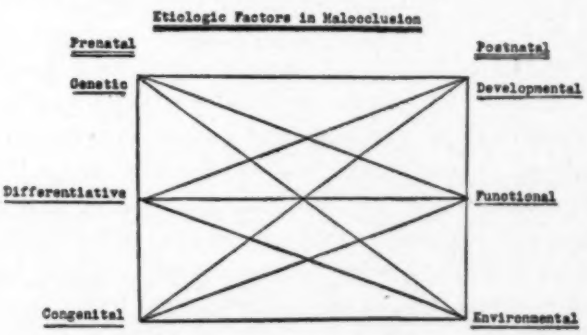

Fig. 1.

CLASSIFICATION OF ETIOLOGIC FACTORS

Etiologic factors in dentofacial anomalies usually manifest themselves in a highly interrelated state (Fig. 1) and may be classified as (1) prenatal, and (2) postnatal, according to the time when they originate. It should be remem-

bered, however, that what is sometimes accepted as cause of a dentofacial deviation may in effect be but an incidental expression of some other pre-existing cause or the precursor or some succeeding cause.

1. Prenatal causative factors may be grouped as follows:
   a. Genetic or hereditary—those transmitted by the genes.
   b. Differentiative—those which are inborn or engrafted upon the body in the prefunctional, embryonic developmental stage.
   c. Congenital—those which may be hereditary or acquired, but which exist at birth.
2. Postnatal causative factors may be divided as follows:
   a. Developmental—those which manifest themselves during the active growth period.
   b. Functional—those due to lack of, or faulty function or to over-function.
   c. Environmental or acquired.

PRENATAL ETIOLOGIC FACTORS

When considering the influence of heredity and environment, it must be kept in mind that the genetic endowment, which is a prenatal factor, exerts a definite influence on the method and severity with which both prenatal and postnatal environmental phenomena are likely to express themselves on the physical well-being of the child. In other words, it is not a question of attributing certain etiologic factors either to heredity *or* environment. Since one influences the other, it may well be heredity *and* environment which are responsible for certain dentofacial anomalies.

The teeth and jaws, like other organs, and the body as a whole, may or may not reach the full potentialities of their inherent prenatal growth pattern. Genetic, ontogenetic and environmental forces which insure normal occlusion by their proper interaction can produce malocclusion if they fail to react properly. Furthermore, all etiologic forces, whether prenatal or postnatal, may express themselves either singly or in combination in a constitutional or dentofacial form, or in both forms.

The various etiologic factors in malocclusion may produce disturbances in the structure, function and form of the dentofacial tissues. These disturbances may be symmetrical or asymmetrical and of varying degrees of severity. They may be confined to one tooth, to several teeth, or to the entire denture; they may involve the osseous structure of the jaws alone, or all of the foregoing.

Genetic factors are transmitted by the genes, which may endow the child with unfavorable as well as favorable characters. Castle[7] describes as lethal genes, those which produce babies so malformed as to be stillborn, and as sublethal genes, those which are responsible for harmful, but not necessarily fatal, anomalies which may be present at birth or may manifest themselves at any period during the life of the individual. The harmful effects produced by the sublethal genes may take the form of hereditary diseases and malformations of the muscles, sense organs, the blood and other systems. They may render the individual more susceptible to certain diseases, habits, or even to accidental traumatic injuries in his postnatal environment.

The fact that certain characteristics of the face and teeth of vertebrates, including man, are inherited with a regularity which would make possible the prediction of the recurrence of these characteristics in subsequent generations and in accordance with Mendelian laws, has been shown by numerous writers, as Stockard[29] and his collaborators working with dogs, and recently in humans by Lebow and Sawin,[17] who presented a pictorial pedigree of seven generations, including 42 individuals.

Ritter,[24] in a study of 126 fraternal and 96 identical twins, found that monovular twins generally show concordance of malocclusion, while discord is more common in biovular twins. Burks[6] found deficiency in number of the teeth to follow a genetic pattern and to be transmissable both from the father and mother. A high coefficient of correlation has also been found to exist in many of the facial dimensions of parents and their offspring.[13]

Genetic factors may be summarized as follows:

1. Dentofacial clefts.
2. Bimaxillary protrusion and atresia.
3. Macro- and micromandibular growth.
4. Anomalies of structure, size, number, and position of teeth.
5. Ectodermal dysplasias.

In order for an anomaly to warrant being considered of genetic origin, it must have occurred and been well-defined in several relatives and must follow the Mendelian laws of transmission. A genetic diagnosis of malocclusion should not be made on the basis of a single case of recurrence in a family.

Differentiative factors in malocclusion may be recognized by the failure of the embryo to undergo normal morphologic differentiation in one or more of its dentofacial components. These are ontologic deficiencies which occur in the early, prefunctional embryonic stage and are not necessarily of genetic origin. Spemann[28] has shown that inductive factors, present in certain cells which he calls "organizers" or "organizators," dominate the earliest stages of development of the various organs of the embryo. Brodie[4] is in fact referring to these "organizers," as originally described by Spemann, when he speaks of "a series of 'fields,' or 'differentiated areas,' each destined to give rise to its own particular tissue or organ," as appearing in the nonspherical stage of the fertilized ovum.

Failure of certain organizers to function may result, for example, in complete arrest of development of facial components. Dysfunction of the organizers of the dentofacial components is responsible for certain developmental deficiencies and abnormalities of the mouth and the teeth, including harelip, cleft-palate and other dentofacial anomalies.

Congenital dentofacial malformations, i.e., anomalies present at birth, may be due to an abnormal state of the mother during pregnancy, such as malnutrition, endocrine disturbance, infectious disease, such as syphilis, as well as to morphologic, metabolic, nutritional and traumatic disturbances of the fetus itself.

Holt and McIntosh[16] have shown that the so-called "position of comfort" or posture of the fetus during gestation is often responsible for gross asymmetries and developmental anomalies of the head, face, and jaws, ranging from

dislocations of the mandible to atrophy of one or more of the dentofacial components.

Accidents of pregnancy and childbirth as well as genetic and differentiative causative factors are also responsible for congenital anomalies which distort the inherent growth pattern.

Murphy[21] found harelip and cleft palate to be the most common defects involving the musculo-skeletal system. He found congenital abnormalities to occur twenty-five times more frequently in families already possessing a malformed child than in the general population.

Congenital factors may be summarized as follows:

1. Abnormalities in pregnant mother—nutritional, endocrinopathic, infectious.
2. Disturbances of fetus—metabolic, nutritional, developmental.
3. Accidents of pregnancy and childbirth trauma.

POSTNATAL ETIOLOGIC FACTORS

Postnatal causative factors occur as a result of developmental deficiencies, functional disturbances, and environmental interferences.

Developmental dentofacial anomalies of postnatal origin are dependent on the nature and severity of the disturbance which occurs during the growth period. Wetzel,[34] by means of his "Grid Technique," has shown that the progress of "physical fitness" in the child is disturbed by disease, malnutrition, and other unfavorable growth conditions. Todd,[30] Broadbent,[3] Francis,[9] and others found children retarded in general skeletal growth to be usually retarded also in tooth development and in facial growth.

General postnatal developmental factors may be summarized as follows:

1. Anomalies in rate of growth of various body organs.
2. Muscular weakness.
3. Endocrine, nutritional, metabolic and infectious diseases.
4. Anomalies of dentofacial growth.
5. Anomalies of tooth development and eruption.

Postnatal functional factors in malocclusion are especially important during childhood, since function and form are interrelated. Baker,[2] Cieszynski,[8] Rogers,[25] Wallis,[32] and others have shown the interdependence of muscular function and jaw growth. Rogers'[25] method of myofunctional therapy is based on the principle of modification of form by function. Selmer-Olsen,[26] however, points out that function has no effect on the basal growth of the jaws beyond the limits set by the inherent growth pattern and that continued stimulation of the jawbones beyond this pattern by orthodontic means or otherwise will tend to break down the jawbones.

The functional effect of the physical nature of food, as well as the method of mastication and deglutition, are considered by Wallace,[31] Waugh,[33] Price,[22] and others to be causative factors in normal, as well as in abnormal, jaw development.

Postnatal functional factors may be summarized as follows:

1. Muscular disturbances.
2. Neurotrophic, endocrine, and nutritional deficiencies.

3. Respiratory disturbances.
4. Postural defects.
5. Disturbances in forces of occlusion.
6. Dentofacial muscular insufficiency or hyperfunction.
7. Loss of teeth or disease interfering with mastication.

Postnatal environmental or acquired factors of malocclusion are perhaps best known to practitioners of orthodontics and include all of the various general and local physical disturbances which interfere with the growth and normal relationship of the teeth and jaws. If it is possible for orthodontists to produce desirable modifications in the occlusion of the teeth and relationship of the jaws by means of force exerted locally by orthodontic appliances, it is reasonable to conclude that local forces resulting from disease, malnutrition, traumatic accidents, malfunction, harmful pressure habits, etc., to which persons may be subject during life, may exert a deleterious effect on the rate and direction of growth as well as on the anatomic relationship of their dentofacial components.

Whether or not local forces, as just mentioned, will produce, or can produce, dentofacial anomalies in a specific individual depends on their combination and interaction in each case. For example, neither malfunction nor harmful pressure habits are likely to produce malocclusion unless some other factor which affects bone stability is present.

Postnatal environmental factors may be summarized as follows:

1. Diseases indirectly affecting the dentofacial components.
2. Accidental trauma.
3. Disturbance in forces of occlusion.
4. Premature loss or prolonged retention of deciduous teeth.
5. Delayed or accelerated eruption of teeth.
6. Diseases of the dentofacial components.
7. Dentofacial trauma.
8. Dentofacial habits; pressure habits.

The following, based on an elaboration and modification of terms employed by Lischer,[19] may be regarded as a primary diagnostic classification of dentofacial anomalies from the standpoint of their etiologic origin and according to the extent and severity of the manifested deviation:

I. *Cephalic anomalies:* Deformities of the osseous components of the head in general which affect dental occlusion and dentofacial development. Treatment of malocclusion by orthodontic means alone in these cases is not effective and is usually of questionable value even as an adjunct to surgery.

II. *Dysgnathic anomalies:* Gross developmental abnormalities of the jaws and oral structures which influence dentofacial relationship. These gross abnormalities may affect the maxilla, the mandible, or both jaws. They are usually not amenable to orthodontic treatment, excepting as an adjunct to surgical or other therapy or when confined to the dental arches alone when sufficient basalar bone is present to accommodate all of the teeth, otherwise extraction of individual teeth may be necessary.

III. *Eugnathic anomalies:* Positional anomalies of the teeth alone which influence occlusion. Orthodontic therapy is, as a rule, highly effective in these types of malocclusion.

Dentofacial deviations, when considered from the etiologic point of view, may thus be seen to be the local symptomatic manifestations, the end results, or both, of underlying causes which, as a rule, cannot be specifically determined. Different etiologic factors may be responsible for the same type of malocclusion and, contrarily, malocclusions of the same type may be due in whole or in part to various unrelated etiologic factors. Orthodontists are well aware that patients with malocclusion of similar classification and degree of severity may respond differently to the same method or so-called "system" of treatment. In view of the foregoing, etiology alone is not sufficient for establishing a diagnosis requisite to the choice of a procedural method in the treatment of malocclusion.

CLASSIFICATION IN RELATION TO THE DENTOFACIAL NORM

According to Quetelet,[23] biometrics is one of the methods that may be used in establishing biologic norms. The norm is accepted to be $M \pm \sigma$ (M denoting the middle value), in other words, the norm is the middle value within a range of certain plus or minus deviations. It may readily be seen that some anomalies may well fall within the limits of the norm. Whether or not certain occlusal and dentofacial deviations actually are within the normal or the abnormal range in a particular individual depends on the body-type of the particular individual in whom they occur.

Types of classification according to various norms may be summarized as follows:

1. Tooth and jaw relationship—Angle.
2. Skull and denture relationship—Simon, Broadbent.
3. Facial growth related to dental development.—Hellman.

Norms for the classification of dentofacial anomalies have been variously established by different men. However, the reliability of the different norms has been questioned and their postulation has led to interminable discussion and a great deal of objection, mainly because the norms were found to be not invariable. The fact remains that the men who established the different norms usually admitted their shortcomings. Thus Simon[27] pointed out that his norm must be regarded in the light of the "as-if" theory propounded by Vaihinger; that it was a "necessary fiction."

The aim of diagnosis in orthodontics, however, is not the blind pursuit of the elusive dentofacial or dental norm. Consideration must be given to the body-type and general state of health of the patient, the rate and direction of facial growth and dental development, such as the presence or absence of teeth in their accepted or normal positions, and in their proper sequence according to the state of maturation, bone age, and nutritional status of the individual patient. As an important afterthought, it should be remembered that true symmetry is never found in biologic entities. It can be seen, therefore, that, while classification is one part of diagnosis, it is by no means all of diagnosis.

"DEVELOPMENT AND GROWTH" IN DIAGNOSIS

In view of the dynamic influence of what is generally known as "development and growth" on the occlusion of the teeth, it was only natural that the deficiency of the static method of classification of malocclusion should become generally recognized and other methods should be sought as a basis of classification as an aid in diagnosis.

Mershon,[20] as a result of his clinical observations, was among the first to call attention to the factor of inherent differentiation and growth which takes place in the child regardless of the presence or absence of orthodontic treatment. Hellman,[15] Broadbent,[3] Brodie,[5] and others in our country and orthodontists elsewhere then began to probe into the question of so-called "growth and development," which has since become a fetish in orthodontics. In a recent publication Hellman states: "Now, there is more being claimed about growth and development than is reconcilable with actual results in orthodontic practice."[14]

In 1937, Hellman announced his polygons or "wiggles" for the appraisal of facial dimensions in correlation to his stages of dental development. These standards are not absolute, but are constructed on a ± variation about the mean of each of the facial dimensions.

Hellman found most faces to show deviation from his normal standards, or facial polygons. Faces may conform to the normal standard in two planes and show deviation in the third plane, thus accounting for the variation in facial measurements in the presence of normal occlusion. Hellman's standards are useful in diagnosing the progress or lack of progress in growth of the face but, as he himself points out,"—appraising the faces of orthodontic patients does not imply the diagnosis of malocclusion of the dentition."

While the appraisal of facial growth and dental development alone, as has been shown, is not all of diagnosis, it is, or we should say, it *could be,* an important factor in diagnosis when sufficient knowledge is made available and the accurate use of facial growth norms and the use of the instruments for obtaining facial measurements, are more generally understood.

THE MATURATIVE AGE OF THE PATIENT

Age, as used here, refers to the chronologic, anatomic, physiologic, and maturative or developmental ages. These three ages may or may not coincide in the same patient. It is important, nevertheless, to correlate these ages in order to give them due consideration in diagnosis.

Diagnosis in the deciduous dentition has been the *terra incognita* of dentistry. The approach to the examination of the dentition of the child patient by the orthodontist, until comparatively recent years, and this is true of the general practitioner of dentistry even today, has been that of dealing with a small-sized adult. However, the examination of the dentition of the child, whether for general dental operations or orthodontic purposes, must always be made from the standpoint of the dynamic changes which the occlusion of the teeth is undergoing as a result of dental development and facial growth.

According to Gesell,[12] "It is not the status at a given moment, but the growth characteristics of the individual career which are important from the

standpoint of child health and protection. Periodic diagnosis then becomes the basis for developmental supervision.'' The same may also be said of orthodontic supervision.

The time factor constitutes a fourth dimension in the measurement of the dentofacial development of the child and is the basic difference between the dental or orthodontic examination of the child in contradistinction to that of the adult.

Differential diagnosis in the deciduous and the mixed dentitions is not to be based on a single examination. The alignment of the permanent teeth cannot be predicted on the degree of perfection present at any time in the alignment of the deciduous teeth, nor is interdental spacing in the deciduous denture an invariable diagnostic sign of normal alignment in the incoming permanent dentition. Premature loss of deciduous teeth, as we know, is not necessarily followed by malocclusion. Likewise, the size of the deciduous teeth is not an index to the size of the permanent dentition.

Diagnosis of malocclusion in the mixed dentition (transition period) usually is a difficult procedure because the jaws and teeth are undergoing rapid changes of growth and position, so that many cases of apparent malocclusion are in effect phases of growth. Conditions in the individual patient that may be classified as malocclusion at one age level may be considered normal at some other level, while treatment indicated at one age level may be contraindicated at some other age level. For example, Friel[10] has shown that deep overbite in the unworn deciduous denture at age 3 to 4 years may disappear as wear of the occluding surfaces of the teeth takes place and the mandible grows forward. Similarly, Broadbent[3] has described what he terms ''the ugly duckling stage.'' Lewis[18] found over 50 per cent of cases of normal occlusion in the deciduous denture to show malocclusion during the mixed dentition period.

Serial examinations are of especial value during the mixed dentition period, when the deciduous teeth may be abnormally resorbed, prematurely lost, or retained beyond their physiologic age. Broadbent,[3] Lewis,[18] Hellman[14] and others have shown that certain self-corrective changes take place during the mixed dentition stage.

Diagnosis of dentofacial anomalies when the permanent dentition has erupted is more positive, and more sustained treatment of the various classifications of malocclusion, as well as of individual teeth may be undertaken. Occlusal conditions after the twelfth year are usually the end results of previous growth changes, although some facial changes still occur, and there is a slight increase in length of the dental arches when the third molars are erupting.

In conclusion, it is important to point out that each of the foregoing diagnostic considerations and procedures does not stand alone and cannot be used individually, but should be employed collectively as a basis of diagnosis for planning treatment.

There has always been a tendency on the part of so-called practical men in dentistry, and this is no less true of orthodontics, to deride theory and theorists. Some go so far as to express the belief that we are ''too scientific.'' Medicine and its specialties have outgrown these men; how long will it take dentistry to outgrow them? The one who calls himself a practical man is apt

to ask "What good are all of these theories?" One may as well ask, says Zinsser,[36] "What good is a newborn baby?"

Lately there has been such an upsurge in the ranks of the practical men that mothers now ask us if we can treat children in eleven months and what kind of bracket bands and wires we intend to use. It is hard to imagine a mother asking a surgeon what kind of an incision he intends to make, or what kind of instruments he is going to use. After all, orthodontic appliances *are* the instruments—the means—that we use to accomplish desired ends.

The attitude of the practical man who attempts orthodontic treatment toward those who direct his attention to the basic scientific theory underlying treatment brings to mind a modified version of a well-known story. I have reference to the old fable of the sick horse who had fallen and of the professor who sat down beside him and tried to figure out theoretically how to get the horse up on his feet, when along came a farmer who twisted the horse's tail, quickly bringing him on his feet. However, after the horse walked a few paces, he again fell down, this time never to get up again. The practical farmer had neglected to make a diagnosis. It is not a question of getting the horse up on his feet only, but also how to keep him there.

In orthodontics it is not only a question of therapy—pushing teeth around —but rather, therapy based on proper diagnosis to determine when and where teeth belong and whether they will remain in their new positions after they have been moved. It is the proper correlation of diagnostic method, largely the work of the theorists, to practical treatment planning that should be the determining factor in the adoption of a procedural method for the successful treatment of malocclusion.

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A STATISTICAL ANALYSIS OF THE INCIDENCE OF NUTRIENT CHANNELS AND FORAMINA IN FIVE HUNDRED PERIAPICAL FULL-MOUTH RADIODONTIC EXAMINATIONS

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WHILE the larger channels and foramina of the maxilla and mandible, such as the mandibular canal and the mental foramen, have been minutely described for years in all standard anatomy textbooks, apparently the much smaller nutrient channels and foramina were disregarded until 1927 when Hirschfeld[5] described them. He named the channels "interdental canals" and described them as follows:

1. The linear and circular radiolucent areas described in this paper are produced by interdental canals and their foramina, respectively, which are normal anatomic features and not the result of pathologic bone destruction.
2. They may be mistaken for evidence of periodontal disease in the same way as are some of the other normal radiolucent markings.
3. A knowledge of their anatomic characteristics may serve as an important aid in diagnosis.
4. In certain instances of doubtful periapical or parietal radiolucent areas in the lower incisor region, it is advisable to take additional radiograms at different angles for the purpose of ruling out anatomic features.
5. The function of the interdental canals and foramina is to transmit well-sized blood vessels through which the inferior dental and sublingual arteries anastomose.
6. The constancy with which the foramina appear in the mandibles, not only of man, but also of other mammals, and in approximately the same relative position, suggests their functional importance.

In 1933 Batson[3] suggested that the name "interdental canals" be changed to the more descriptive "nutrient canals." Since then they have been mentioned in this manner in a few communications[7, 8] and radiodontic textbooks.[3, 4, 6] It is now proposed that nutrient "channels" would be a better designation. In dental anatomy "canal" means a "tubular channel."[1] Since these "nutrient channels" are sometimes tubular and at other times merely a groove, the word "channels" seems to be more apt for it means "a canal, groove, or deep furrow."[2] The word canal can still be used to advantage for tubular channels such as the mandibular canal.

During the preparation of an article on radiodontic channels and foramina it became apparent that the value of the article would be greatly enhanced by reference to data on the incidence of such channels and foramina in periapical full-mouth radiodontic examinations. A careful study of the available literature

failed to reveal any such data, so it was necessary to make our own study. We believe this to be the first statistical analysis of this subject.

At first a group of 100 full-mouth examinations was deemed sufficient, and it was planned to exclude incisive and mental foramina and the mandibular canal. Soon after beginning the study it was decided that it would be much better to include these anatomic features because they also are nutrient channels and foramina. For statistical purposes the number of full-mouth examinations was increased to 500. With a larger number, it would be possible to draw conclusions that should present a true picture of the occurrence of these anatomic features in both the maxilla and mandible. All observations were correlated with the age and sex of each individual examined radiographically.

Fig. 1.—Photograph of mandible disclosing two large nutrient foramina at approximately the level of the apices of the mandibular incisor teeth. Several small nutrient foramina are also visible below the larger foramina.

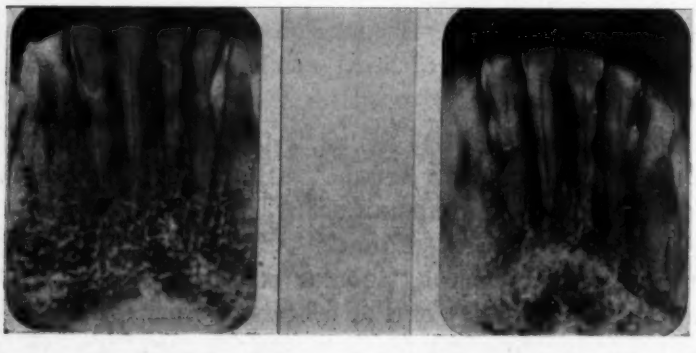


Fig. 2.—Periapical radiographs of the mandible shown in Fig. 1. Arrows point to the images of the large nutrient foramina. These images might be incorrectly interpreted as areas of osteoclasia.

The importance of securing information concerning the incidence of nutrient channels and foramina is emphasized when the mandible shown in Fig. 1 is considered. Two very large nutrient foramina are located at the level of the apex of the incisor teeth. Radiographs of this dry specimen, Fig.

2, show how easily these foramina might be mistaken for areas of osteoclasia were this a live subject.

MATERIAL

Five hundred consecutive periapical full-mouth radiodontic examinations of the employees (134 females, 366 males) of a large manufacturing concern were used. Two-film packets were employed, one of the films from each packet being sent unprocessed to the author. No selection of cases was made except where less than a full-mouth examination had been made; these were rejected. Every examination used consisted of a minimum of fourteen exposures while in some cases as many as twenty-four exposures were employed.

PROCEDURE

All films were processed with the standardized time-temperature technique, dried and mounted in 8½– by 10–inch dental film mounts. They were then viewed on an x-ray illuminator fitted with blue-flashed opal glass and a Mazda 100-watt blue glass bulb. Sufficient time was taken to study all parts of the mouth carefully in every case, the channels and foramina discovered in each area were recorded on a large data sheet, Fig. 3.

In making this study the mouth was divided into areas according to the location of teeth. The areas thus arbitrarily established were maxillary incisor, maxillary cuspid, maxillary bicuspid, maxillary molar, mandibular incisor, mandibular cuspid, mandibular bicuspid, and mandibular molar. Since the antra occupy a large part of the maxilla and in many instances nutrient channels and foramina are disclosed radiographically within them, a column was provided for these sinuses. A column was also provided for the nose for in many radiographic examinations its bony structures record themselves on the radiograph of the maxillary central incisors. Columns were provided for the incisive and mental foramina and the mandibular canal. Finally two columns were provided in which to record the sex and age of the individual.

As this article progresses, we will write of "findings." We may define a finding as the presence of a channel or foramen in the various areas into which the mouth was arbitrarily divided in making up the data sheets. Thus there are forty-five possible findings in each case as follows:

Upper incisor area, channel or foramina, right or left	4
Upper cuspid area, channel or foramina, right or left	4
Upper bicuspid area, channel or foramina, right or left	4
Upper molar area, channel or foramina, right or left	4
Lower incisor area, channel or foramina, right or left	4
Lower cuspid area, channel or foramina, right or left	4
Lower bicuspid area, channel or foramina, right or left	4
Lower molar area, channel or foramina, right or left	4
In antrum, channel or foramina, right or left	4
Incisive foramen	1
In nose, channel or foramina, right or left	4
Mandibular canal, right or left	2
Mental foramen, right or left	2
Total	45

The interpretation and recording of the data on the data sheets were difficult operations for several reasons. The quantity of work in itself was quite a task, made more difficult by the fact that, when doing work of this nature, there is a tendency to see that which does not exist. In other words, one must fight his imagination at all times. Round medullary spaces are apt to be mis-

✓Channel ×Foramen	Number	Side	Upper Incisor	Upper Cuspids	Upper Bicuspids	Upper Molars	Lower Incisors	Lower Cuspids	Lower Bicuspids	Lower Molars	In Antrum	Incisive Foramen	In Nose	Mandibular Canal	Mental Foramen	Sex	Age
	1.	R L						×	×		✓			✓	×	F	27
	2.	R L					× × × ×				✓			✓	× × × ×	F	25
	3.	R L									✓			✓		F	19
	4.	R L									✓			✓	×	F	19
	5.	R L									✓		✓ ×	✓		M	64
	6.	R L	✓	✓			✓ × ×				✓			✓	× ×	M	27
	7.	R L					✓ × ×	✓			✓	✓		✓	× ×	M	40
	8.	R L					× ×				✓			✓		M	24
	9.	R L									✓	✓		✓		M	38
	10.	R L									✓			✓		M	52
	11.	R L									✓	✓		✓		M	22
	12.	R L									✓	✓		✓		F	24
	13.	R L									✓	✓		✓	× ×	F	23
	14.	R L					× ×				✓	✓		✓	× × ×	M	25
	15.	R L									✓	✓		✓	× × ×	M	24
	16.	R L									✓	✓		✓		M	33
	17.	× R × L	✓	✓	✓		× × × ×				✓	✓	✓	✓		M	46
	18.	R L					× × × ×				✓ ×	✓	✓	✓	× ×	F	26
	19.	R L		×	×		✓ ✓ ✓ ✓				✓	✓		✓		M	20
	20.	R L		×	×		× × × ×				✓			✓	× ×	M	32
	21.	R L					✓ ✓				✓			✓	× ×	M	47
	22.	R L					× ×				✓			✓	× ×	M	47
	23.	R L						✓			✓	✓		✓		F	27
	24.	R L ✓	✓				✓ ✓	✓	✓ ✓		✓			✓	×	F	26
	25.	R L									✓			✓		M	25
	26.	R L		×	×		× × ×				✓			✓	×	M	31
	27.	R L									✓			✓	× × ×	M	24
	28.	R L					× ×				✓	✓		✓	× × ×	M	25
	29.	R L									✓	✓		✓		M	41
	30.	R L									✓			✓	× ×	M	26
	31.	R L									✓			✓		M	30

Fig. 3.—Photograph of data sheet used to record findings during interpretation of the radiodontic examinations.

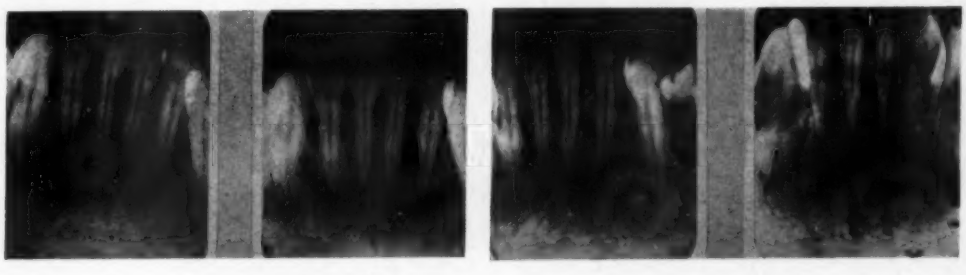
taken for nutrient foramina, channels are to be seen where closer examination reveals none, even the mental foramen and the mandibular canal can be projected by the imagination into the radiographs unless one is very careful. Early recognition of these dangers led to the recording of only that data about which there could be no reasonable doubt. When considering the mandibular

canal it was decided to record it as being present whenever it could be seen, if only for a short distance on the radiograph. It is seldom that the canal is clearly shown throughout its length.

Many nutrient channels and foramina that were recorded as being within the antra were located close to the cuspid, bicuspid, and molar roots. It was decided, however, that every finding that appeared within the antra should be recorded as such no matter how near to the teeth.

A. *B.*

Fig. 4.—Periapical radiographs of the maxillary bicuspid-molar region disclosing nutrient channels.



A. *B.* *C.* *D.*

Fig. 5.—Periapical radiographs of the mandibular incisor region disclosing many nutrient channels and foramina. Radiographic images such as these have sometimes been incorrectly diagnosed as evidence of pathosis. Note in *D* that alveolar resorption is so extensive that the foramina have disappeared, the channels apparently reach the surface at the crest of the ridge.

Fig. 6.—Periapical radiograph of the mandibular bicuspid-molar region disclosing many nutrient channels. It is exceptional, in this region, to find such a fine network of small nutrient channels interwoven between the larger nutrient channels.

In some cases, findings that appeared to be within the antrum were probably actually outside, for the image of the antrum could overcast the image of the finding. Since there was no way of discovering the exact truth from the radiograph alone, confusion was avoided by recording all findings as within the antra when they appeared to be so located.

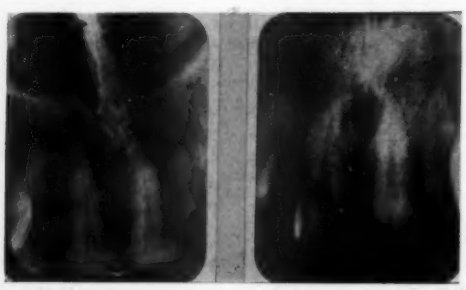
After all the examinations had been interpreted and the findings recorded on the data sheets, analyses and various tabulations were made.

NUMERICAL INCIDENCE

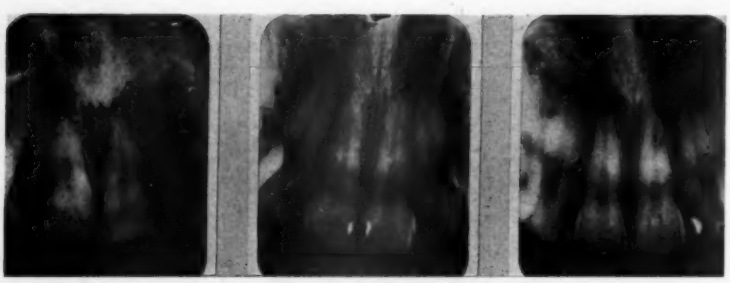
The first information taken from the work data sheets was merely a translation of the checks and crosses used into a numerical tabulation according to the columns on the sheets. This is shown as Table I.

A. *B.*

Fig. 7.—Periapical radiographs of the maxillary bicuspid region disclosing large nutrient channels running along the side walls of both antra. Note that several smaller nutrient channels are also shown.



A. *B.*



C. *D.* *E.*

Fig. 8.—Periapical radiographs of the maxillary incisor region. In *A* the image of the incisive foramen is clear-cut and easily discovered. In *B*, *C*, *D*, and *E* the margin of the incisive foramen is more and more diffused until at *E* it is impossible to outline the foramen.

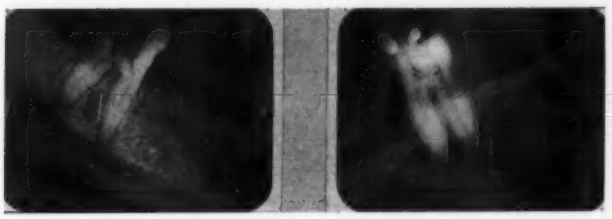
TOTAL NUMERICAL INCIDENCE PER INDIVIDUAL

Next a tabulation, Table II, was made of the total number of findings per individual by sex and the resultant total in each case.

INCIDENCE BY AGE GROUPS

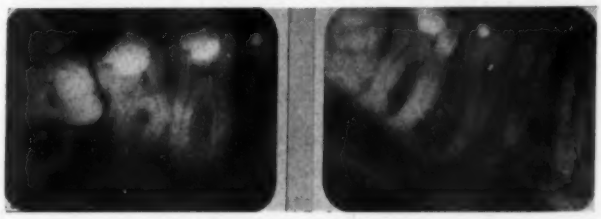
Since the material was all obtained from working people, it will be impossible to present or discuss data concerning children or elderly people. The

A. *B.* *C.*

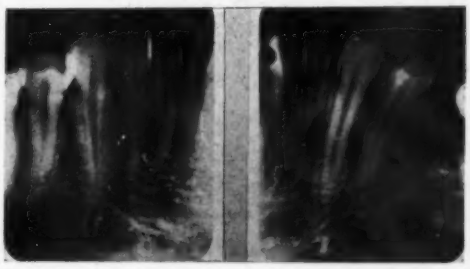


D. *E.*

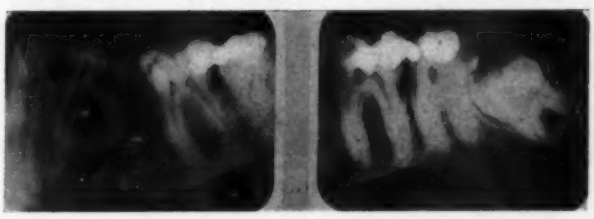
Fig. 9.—Periapical radiographs of the mandibular molar region disclosing the mandibular canal. In *A*, *B*, and *C* the image of the canal is discernible from the point where it enters the radiographic field to its exit. In *D* the image of the canal is vividly shown at the point of entrance but fades out and is lost in the bone structure. In *E* it is difficult to differentiate the image of the canal from the surrounding bone. Note in *D* the small vertical nutrient channels below the mandibular canal.



A. *B.*



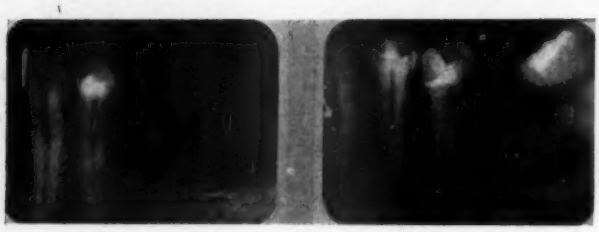
C. *D.*



E. *F.*

Fig. 10.—Bilateral periapical radiographs of the mandibular molar to cuspid region disclosing an abnormally large and misshapen mandibular canal on each side. Both canals are oversize, bulge out at intervals, and extend into the incisor region.

A. *B.*

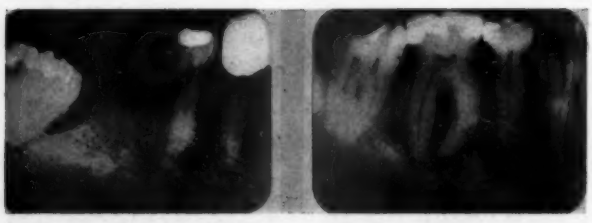


C. *D.*

Fig. 11.—Periapical radiographs of the mandibular bicuspid-molar region failing to disclose the mandibular canal. In some cases this is due to the formation of the bone, in others to the fact that the periapical radiograph did not cover enough area below the roots.

A. *B.*

C.



D. *E.*

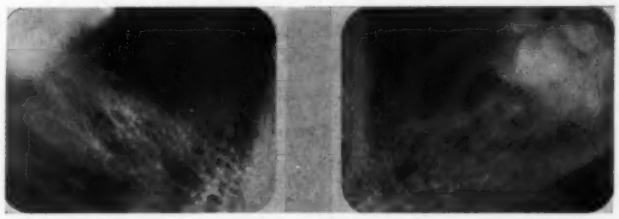
Fig. 12.—Periapical radiographs of mandibular molar, bicuspid, and cuspid regions disclosing the image of the mental foramen in close proximity to the roots of the mandibular second bicuspid teeth. There is danger of such images being incorrectly interpreted as areas of osteoclasia. Note in *C* how the mandibular canal hooks back to the apex of the second bicuspid, also the mesiad extension of the canal. In *E* the mandibular canal curves back up the distal side of the second bicuspid root, the image of the foramen partially overcasting that of the mesial root of the first molar well above the apex.

youngest individual was eighteen years of age, the oldest sixty-four. The correlation of findings with age, by decades is shown in Table III, and it will be noticed that the first decade (18 to 20) and the last (61 to 64) contain relatively few individuals when compared to the decades between.

PERCENTAGE OF FINDINGS

The percentages of occurrence of the various findings are recorded in Tables IV, V, and VI. Table IV shows the number of times the findings occurred in each area and the percentage of occurrence of each finding in the total number of cases. Table V shows the same data correlated by sex. Table VI records the average percentage of findings for each sex.

Fig. 13.—Periapical radiograph of the mandibular bicuspid region disclosing the mental foramen at the apex of the mandibular second bicuspid. Since the mandibular canal leading to the foramen is vertical, it might be incorrectly interpreted as a fistula. Note the abnormally large continuation of the mandibular canal mesiad from the cuspid.



A. *B.*

Fig. 14.—Periapical radiographs of the mandibular bicuspid region. The images of the mental foramina seem to be more vividly recorded radiographically in edentulous areas.

EDENTULOUS AREAS

Soon after the work of interpreting the radiographs was begun, it was noticed that findings seemed to appear (in the maxilla at least) with greater frequency in edentulous areas than in areas in which the teeth were present. A decision to investigate the validity of the observation was carried out in the following manner. Four of the 500 individuals whose radiographs were being examined were edentulous in the maxilla. These four individuals, all males, had respectively, eighteen, sixteen, sixteen, and eight findings. If these four individuals were taken as a separate group, the average number of findings for this group when compared against the average number of findings of the 500 individuals should, if sufficiently definite, be conclusive in spite of the small number of individuals in the group. The result of the comparison is shown in Table VII.

TABLE I

NUMERICAL INCIDENCE OF FINDINGS

AREA	MALE	FEMALE	TOTAL
Channels in right maxillary incisor	2	2	4
Channels in upper left incisor	4	3	7
Channels in both right and left maxillary incisor	9	1	10
Foramina in upper right incisor	8	0	8
Foramina in upper left incisor	5	2	7
Foramina in both right and left upper incisor	7	1	8
Channels in upper right cuspid	7	0	7
Channels in upper left cuspid	1	0	1
Channels in both right and left upper cuspid	4	1	5
Foramina in upper right cuspid	7	1	8
Foramina in upper left cuspid	7	3	10
Foramina in both right and left upper cuspid	3	1	4
Channels in upper right bicuspid	12	3	15
Channels in upper left bicuspid	9	1	10
Channels in both right and left upper bicuspid	10	1	11
Foramina in upper right bicuspid	13	5	18
Foramina in upper left bicuspid	10	3	13
Foramina in both right and left upper bicuspid	9	3	12
Channels in upper right molar	7	0	7
Channels in upper left molar	2	1	3
Channels in both right and left upper molar	2	0	2
Foramina in upper right molar	2	1	3
Foramina in upper left molar	1	0	1
Foramina in both right and left upper molar	0	0	0
Channels in lower right incisor	5	0	5
Channels in lower left incisor	2	1	3
Channels in both right and left lower incisor	65	10	75
Foramina in lower right incisor	8	0	8
Foramina in lower left incisor	3	0	3
Foramina in both right and left lower incisor	52	13	65
Channels in lower right cuspid	4	1	5
Channels in lower left cuspid	3	0	3
Channels in both right and left lower cuspid	7	1	8
Foramina in lower right cuspid	4	1	5
Foramina in lower left cuspid	3	0	3
Foramina in both right and left lower cuspid	1	0	1
Channels in lower right bicuspid	6	1	7
Channels in lower left bicuspid	4	0	4
Channels in both right and left lower bicuspid	2	2	4
Foramina in lower right bicuspid	6	2	8
Foramina in lower left bicuspid	4	0	4
Foramina in both right and left lower bicuspid	1	0	1
Channels in lower right molar	1	0	1
Channels in lower left molar	0	0	0
Channels in both right and left lower molar	1	0	1
Foramina in lower right molar	0	0	0
Foramina in lower left molar	1	0	1
Foramina in both right and left lower molar	0	0	0
Channels in right antrum	27	12	39
Channels in left antrum	25	7	32
Channels in both right and left antra	187	72	259
Foramina in right antrum	12	4	16
Foramina in left antrum	7	2	9
Foramina in both right and left antra	7	3	10
Incisive foramen	195	63	258
Channels in right side of nose	0	1	1
Channels in left side of nose	3	2	5
Channels in both right and left sides of nose	2	8	10
Foramina in right side of nose	2	0	2
Foramina in left side of nose	1	0	1
Foramina in both right and left sides of nose	0	0	0
Right Mandibular canal	27	9	36
Left Mandibular canal	22	4	26
Both right and left Mandibular canals	286	118	404
Right mental foramen	29	16	45
Left mental foramen	49	17	66
Both right and left mental foramina	134	69	203

DISCUSSION OF DATA

Table I.—Since this is merely a tabulation of the data from the work data sheets, no particular discussion is necessary. It will be noted, however, that it illustrates at this early stage of the investigation the areas in which one may expect to find the images of nutrient channels and foramina when interpreting full-mouth periapical radiodontic examinations. Subsequent tabulations reveal this in detail.

TABLE II

TOTAL NUMERICAL INCIDENCE PER INDIVIDUAL

	FEMALE	MALE	TOTAL
0	2	4	6
1	1	10	11
2	10	15	25
3	10	29	39
4	19	58	77
5	25	72	97
6	26	54	80
7	17	50	67
8	10	21	31
9	7	21	28
10	5	7	12
11	1	7	8
12	0	7	7
13	0	1	1
14	1	6	7
15	0	0	0
16	0	2	2
17	0	1	1
18	0	1	1
	134	366	500

Table II.—This tabulation shows the number of findings, from a possible total of forty-five, found per individual, both female and male, in all the radiodontic examinations. A total of six examinations, two from females and four from males, disclosed no evidences whatever of the existence of nutrient channels and foramina, either large or small. Eleven examinations, one from a female and ten from males, showed only a single finding. The number of individuals having two, three, and four findings progressively increased until the largest number was recorded of individuals with five findings each. Of this group of ninety-seven, twenty-five were females, seventy-two were males. From this peak a decrease occurred rapidly. No individual of either sex had fifteen findings, two males had sixteen findings, one male had seventeen findings and, finally, another male had eighteen findings out of a possible forty-five.

This tabulation seems to indicate that the average would be about five findings.

Table III.—Several interesting conclusions can be drawn from this tabulation. In it the findings are recorded by age groups, in decades, with the percentages of females and males in each group indicated as well as the average number of findings in each group both female and male.

In the first place it is interesting to notice change in the percentage of females in the different age groups. In the first (18 to 20 years) 58.97 per

cent of the group were females. In the second group (21 to 30 years) this has dropped to 34.81 per cent. In the third group (31 to 40 years) there are only about half as many females 17.69 per cent, while in the fourth group (41 to 50 years) the percentage has dropped to 1.47. It rises to 15.78 per cent in the next group (51 to 60 years) and finally there are no women in the last group (61 to 64 years). Each age group shows a loss of women workers (due to marriage apparently) until the final group in which females appear.

TABLE III

INCIDENCE BY AGE GROUPS

AGE GROUPS	18-20	21-30	31-40	41-50	51-60	61-64
Total Number Patients	39	241	130	68	19	3
Number of Females	23	84	23	1	3	0
Percentage of Females	58.97	34.81	17.69	1.47	15.78	0.00
Number of Findings in Females	124	474	141	6	21	0
Average Number of Findings Per Female	5.39	5.64	6.13	6.00	7.00	0.00
Number of Males	16	157	107	67	16	3
Percentage of Males	41.02	65.14	82.33	98.52	84.21	100.00
Number of Findings in Males	87	859	647	431	98	22
Average Number of Findings Per Male	5.44	5.47	6.04	6.43	6.12	7.33

A point much more relevant to our study is the fact that, as the age increases, the average number of findings also increases. While we know that nutrient channels and foramina must exist in all individuals, whether or not they are disclosed in radiodontic examinations, this is the first indication that we have had that the older the individual the more apt we are to discover nutrient channels and foramina.

It is also interesting to note that in each age group, excepting the first and last, the average number of findings per female was slightly larger than per male.

Table IV.—This tabulation, showing as it does the percentage of findings in the various arbitrary areas, gives a clear indication as to where one will be most apt to find images of nutrient channels and foramina in full-mouth radiodontic examinations. As would be expected the mandibular canal will be disclosed in more examinations than any other channel, for it occurred on the right side in 88.6 per cent and on the left in 86.8 per cent of the 500 examinations. Next in frequency of occurrence were channels in the antra, 59.8 per cent being disclosed on the right side and 58.2 on the left. Next, and of greatest importance in radiodontic interpretation, was the discovery that nutrient channels were found in the mandibular incisor area on the right side in 16 per cent and on the left side in 15.6 per cent of the examinations. We believe this percentage to be larger than is anticipated by most radiodontists.

The right mental foramen was disclosed in 49.2 per cent of the examinations, the left in 54 per cent, and the incisive foramen in 51.4 per cent. Of more importance, however, is the discovery that nutrient foramina are nearly as prevalent in the mandibular incisor area as are nutrient channels, for 15 per cent were disclosed on the right and 13.4 per cent on the left side. Foramina in this area may possibly be mistaken for areas of osteoclasia, Fig. 2.

TABLE IV

FINDINGS BY AREA

	NUMBER	PERCENTAGE
Foramina in Maxillary Right Incisor Area	17	3.40
Foramina in Maxillary Left Incisor Area	13	2.60
Foramina in Mandibular Right Incisor Area	75	15.00
Foramina in Mandibular Left Incisor Area	67	13.40
Channels in Maxillary Right Incisor Area	15	3.00
Channels in Maxillary Left Incisor Area	16	3.20
Channels in Mandibular Right Incisor Area	80	16.00
Channels in Mandibular Left Incisor Area	78	15.60
Foramina in Maxillary Right Cuspid Area	13	2.60
Foramina in Maxillary Left Cuspid Area	14	2.80
Foramina in Mandibular Right Cuspid Area	5	1.00
Foramina in Mandibular Left Cuspid Area	2	0.40
Channels in Maxillary Right Cuspid Area	11	2.20
Channels in Maxillary Left Cuspid Area	6	1.20
Channels in Mandibular Right Cuspid Area	14	2.80
Channels in Mandibular Left Cuspid Area	13	2.60
Foramina in Maxillary Right Bicuspid Area	32	6.40
Foramina in Maxillary Left Bicuspid Area	25	5.00
Foramina in Mandibular Right Bicuspid Area	10	2.00
Foramina in Mandibular Left Bicuspid Area	5	1.00
Channels in Maxillary Right Bicuspid Area	27	5.40
Channels in Maxillary Left Bicuspid Area	22	4.40
Channels in Mandibular Right Bicuspid Area	10	2.00
Channels in Mandibular Left Bicuspid Area	8	1.60
Foramina in Maxillary Right Molar Area	3	0.60
Foramina in Maxillary Left Molar Area	3	0.60
Foramina in Mandibular Right Molar Area	0	0.00
Foramina in Mandibular Left Molar Area	1	0.20
Channels in Maxillary Right Molar Area	8	1.60
Channels in Maxillary Left Molar Area	4	0.80
Channels in Mandibular Right Molar Area	2	0.40
Channels in Mandibular Left Molar Area	1	0.20
Foramina in Right Antrum	24	4.80
Foramina in Left Antrum	19	3.80
Channels in Right Antrum	299	59.80
Channels in Left Antrum	291	58.20
Foramina in Right Nostril	2	0.40
Foramina in Left Nostril	1	0.20
Channels in Right Nostril	12	2.40
Channels in Left Nostril	14	2.80
Incisive Foramen	257	51.40
Right Mental Foramen	246	49.20
Left Mental Foramen	270	54.00
Right Mandibular Canal	443	88.60
Left Mandibular Canal	434	86.80

The incidence of the smaller nutrient channels is greatest in the antra, next in the mandibular incisor area then, in order, in the maxillary bicuspid areas, the maxillary incisor areas, the mandibular cuspid areas, about equally in the maxillary cuspid and mandibular bicuspid areas and rarely in the maxillary or mandibular molar areas.

The incidence of the smaller nutrient foramina is greatest in the mandibular incisor area, next in the maxillary bicuspid area, then, in order, in the antra, the maxillary incisor area, the maxillary cuspid areas, the mandibular bicuspid areas, the mandibular cuspid areas, and rarely in the maxillary or mandibular molar areas.

Since, in a number of instances, the images of the mental foramina were cast at the apex of mandibular bicuspid roots, a separate analysis should be

TABLE V

AREA FINDINGS BY SEX

		NUMBER	PERCENTAGE
Foramina in Maxillary Right Incisor Area	Female	2	1.49
	Male	15	4.09
Foramina in Maxillary Left Incisor Area	Female	2	1.49
	Male	11	3.00
Foramina in Mandibular Right Incisor Area	Female	13	9.70
	Male	61	16.66
Foramina in Mandibular Left Incisor Area	Female	13	9.70
	Male	54	14.75
Channels in Maxillary Right Incisor Area	Female	3	2.23
	Male	12	3.27
Channels in Maxillary Left Incisor Area	Female	3	2.23
	Male	13	3.55
Channels in Mandibular Right Incisor Area	Female	11	8.20
	Male	69	18.85
Channels in Mandibular Left Incisor Area	Female	11	8.20
	Male	67	18.30
Foramina in Maxillary Right Cuspid Area	Female	2	1.49
	Male	11	3.00
Foramina in Maxillary Left Cuspid Area	Female	4	2.98
	Male	10	2.73
Foramina in Mandibular Right Cuspid Area	Female	1	0.74
	Male	4	1.09
Foramina in Mandibular Left Cuspid Area	Female	0	0.00
	Male	2	0.54
Channels in Maxillary Right Cuspid Area	Female	1	0.74
	Male	10	2.73
Channels in Maxillary Left Cuspid Area	Female	1	0.74
	Male	5	1.36
Channels in Mandibular Right Cuspid Area	Female	2	1.49
	Male	12	3.27
Channels in Mandibular Left Cuspid Area	Female	1	0.74
	Male	12	3.27
Foramina in Maxillary Right Bicuspid Area	Female	10	7.46
	Male	22	6.01
Foramina in Maxillary Left Bicuspid Area	Female	6	4.47
	Male	19	5.19
Foramina in Mandibular Right Bicuspid Area	Female	2	1.49
	Male	8	2.18
Foramina in Mandibular Left Bicuspid Area	Female	0	0.00
	Male	5	1.36
Channels in Maxillary Right Bicuspid Area	Female	5	3.73
	Male	22	6.00
Channels in Maxillary Left Bicuspid Area	Female	2	1.49
	Male	20	5.46
Channels in Mandibular Right Bicuspid Area	Female	3	2.23
	Male	7	1.91
Channels in Mandibular Left Bicuspid Area	Female	2	1.49
	Male	6	1.63
Foramina in Maxillary Right Molar Area	Female	1	0.74
	Male	2	0.54
Foramina in Maxillary Left Molar Area	Female	1	0.74
	Male	2	0.54
Foramina in Mandibular Right Molar Area	Female	0	0.00
	Male	0	0.00
Foramina in Mandibular Left Molar Area	Female	0	0.00
	Male	1	0.27
Channels in Maxillary Right Molar Area	Female	0	0.00
	Male	8	2.18
Channels in Maxillary Left Molar Area	Female	0	0.00
	Male	4	1.09
Channels in Mandibular Right Molar Area	Female	0	0.00
	Male	2	0.54
Channels in Mandibular Left Molar Area	Female	0	0.00
	Male	1	0.27

TABLE V—CONT'D

		NUMBER	PERCENTAGE
Foramina in Right Antrum	Female	6	4.47
	Male	18	4.91
Foramina in Left Antrum	Female	5	3.73
	Male	14	3.82
Channels in Right Antrum	Female	84	62.68
	Male	215	58.74
Channels in Left Antrum	Female	80	59.70
	Male	211	57.65
Formina in Right Nostril	Female	0	0.00
	Male	2	0.54
Formina in Left Nostril	Female	0	0.00
	Male	1	0.27
Channels in Right Nostril	Female	10	7.46
	Male	2	0.54
Channels in Left Nostril	Female	9	6.71
	Male	5	1.36
Incisive Foramen	Female	63	47.01
	Male	194	53.00
Right Mental Foramen	Female	85	63.43
	Male	161	43.98
Left Mental Foramen	Female	85	63.43
	Male	185	50.54
Right Mandibular Canal	Female	125	93.28
	Male	318	86.88
Left Mandibular Canal	Female	122	91.04
	Male	312	85.24

TABLE VI

AVERAGE PERCENTAGE OF FINDINGS

Average Percentage of Findings per Female	12.68
Average Percentage of Findings per Male	13.00
Average Percentage of Findings per Individual	12.93

TABLE VII

COMPARISON OF AVERAGE AND EDENTULOUS

Average Number of Findings per Female	5.71
Average Number of Findings per Male	5.85
Average Number of Findings per Individual	5.82
Average Number of Findings per Male Individual in Groups of Four Having Edentulous Maxilla	14.50

made of this problem using the radiographs of at least 500 individuals. We hope in time to be able to do so with this series of 500 full-mouth periapical radiodontic examinations.

Table V.—This tabulation correlates the incidence of findings recorded in Table IV with the sex of the individuals studied. It is interesting to note that the incidence of findings seems to be greater among males than females. In thirty-one instances the percentage in males was higher than in females, while in only twenty-two instances the percentage in females was higher than the males.

Table VI.—This tabulation records the average number of findings for each sex and indicates that the average number of findings per male is 0.22 per cent greater than the average for a female individual.

Table VII.—This tabulation was made to show the comparison between the average individual who has retained his teeth and the one with an edentulous mouth. While it is true that there were no cases that were fully edentulous, there were four male individuals whose maxillae were edentulous. The tabulation shows that the average of these four individuals was nearly three times as great as that for either female or male. This indicates that the teeth, in situ, prevent the disclosure, in the maxilla at least, of many nutrient channels and foramina whose images are overcast on the x-ray film by the shadows of the teeth.

SUMMARY

The incidence of nutrient channels and foramina, as revealed radiographically in 500 consecutive full-mouth periapical examinations are indicated. Their incidence is nearly the same in female and male and on the right and left sides of individuals.

There is a marked tendency for nutrient channels and foramina to show better in the radiograph as the age of the individual increases.

There are some individuals who show, radiographically, no evidence whatever of even the largest nutrient channels, such as the mandibular canal, or the largest foramina such as the incisive or mental. Others will show as high as eighteen findings out of a possible forty-five.

CONCLUSIONS

We believe, after completing this analysis, that the following conclusion is valid:

That greater care should be exercised in the interpretation of dental radiographs to avoid mistaking nutrient channels and foramina for areas of pathosis especially when examining the radiographs of edentulous mouths and of older individuals.

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OBSERVATION AS A DIAGNOSTIC AID IN PLANNING THE MINIMUM OF ORTHODONTIC TREATMENT

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ORTHODONTICS in the past twenty-five years has traveled a long way. There have been many, many changes. How many of these changes represent real progress is another matter, and every one of us can well do some-sound thinking on what has been progress and what has been mere change. In thinking along this line, one must always remember the sound basic principles of orthodontics. One must be familiar with growth and development, particularly of the teeth and jaws, and realize just how important these factors are. The evolutionary tendencies must come in for their full share of consideration. Variation and heredity certainly cannot be forgotten or overlooked at any time. Habits and their importance cannot be disregarded, and one should always keep in mind the physiology of oral structures. Evidently there is still a search being made for that panacea in orthodontic treatment that will give perfect immediate results and prevent any possibility of relapse. If this is not the case then instead it must be just a search for something different in the way of appliances. Otherwise, we would not hear so much about this appliance or that appliance and a new gadget here and another one there. These changes may be perfectly all right and not at all objectionable, but also they may not represent progress.

Orthodontists have long been criticized for treating too many cases and for treating cases too long. There are two attitudes orthodontists can take regarding this. They can disregard such criticism on the grounds that people do not know what they are talking about, or they can feel that possibly the criticism is justified, at least to some extent, and give more thought to ways and means of eliminating such criticism. A period of intelligent observation before making a final diagnosis and placing mechanical appliances might prove to be an important factor in reducing the number of cases treated and the time required in the treatment of others. Some men in orthodontics feel that more thought should be given to the simplifying of treatment in many cases, thereby extending the advantages of orthodontics to a greater number of patients. In so doing, they must consider much more carefully and thoroughly diagnosis, when to treat, and how to treat.

Dr. A. LeRoy Johnson once said: "With the increase of knowledge, diagnosis is becoming more difficult. When normal occlusion was believed to be an ideal condition of mechanical perfection in the relations of the teeth, it was comparatively easy to ascertain the abnormal. We had merely to compare occlusal conditions with our mental picture of perfection to see the imperfections in any denture. Of course on this basis there were very few, if any, perfect ones. It was the common saying that the normal does not exist. An

interesting bit of psychology in view of the fact that normal occlusion was the basis of diagnosis.

"When you think of the child's denture in its true light; when you think of the process of dentition and what it involves, the resorption, loss and eruption of teeth, the growth and differentiation of tissues, the functional interaction of parts; when you think of the inequalities characteristic of growth processes, and of variations in structure due to germinal factors—when you think of the child's denture in its true light, in fact as we know it to be, the problem of the time of treatment holds one in abeyance. We may easily recognize differences between the dentures of different children, but to recognize conditions of tooth relations which exhibit a real abnormality is not easy.

"Diagnosis means the recognition of disease from its symptoms. Treatment signifies the means employed in effecting a cure of disease and is of course governed by the etiologic factors involved. Treatment is secondary to diagnosis. From the standpoint of orthodontics the diagnosis of malocclusion of the teeth of a child means the recognition of tooth relations that are probable hindrances to normal developmental processes. The difficulty in the question of early treatment is not one of treatment but one of diagnosis. Whenever we recognize a condition which interferes with normal development it should be corrected: there is no question of the time of treatment when such conditions are known to exist. The great problem confronting us is to recognize the presence of such conditions."

A period of observation is the one great aid in the making of a final diagnosis and in deciding when and how to treat a case. The following are cases where observation entirely eliminated the use of mechanical appliances or else shortened the time necessary for the wearing of such appliances.

Fig. 1 is the case of a male, 19 years of age, with a marked open-bite. The history shows an individual of average good health or better and one who has an older brother who had a severe open-bite and a very marked relapse after orthodontic treatment. Another brother had a partial open-bite with a fairly good result following the extraction of one premolar and orthodontic treatment. A sister had almost an ideal occlusion at 12 years of age, but she had rampant caries at the same age while at least two of these brothers were practically immune to caries. This patient was told that open-bites had not been treated too successfully but that if he were sufficiently interested in having something done, a survey would be made to determine what seemed to be a good procedure. The case was studied carefully and it was decided to extract four second premolars. This was done Feb. 1, 1937. The case was then observed until the following November, at which time the first premolars were banded carrying labial arches and the case was treated for one year until the following November, when all appliances were removed. The second set of casts shows the condition five months later. The final set of casts shows the case two and one-half years after the removal of all appliances. In the meantime the patient had had a bad automobile accident which deranged his teeth slightly. It seems that the ten months' period of observation following the extractions was a definite aid in deciding when and how to treat as was the observation period following the removal of appliances in determining whether further treatment and retention were indicated.

Fig. 2 is that of a female patient 6 years of age with dental arches usually described as slightly constricted and with lack of space for the permanent incisors. The mandibular incisors are erupting lingually. Some might say that this case should be treated to make space for the permanent teeth, but ob-

Fig. 1.

Fig. 2.

servation was advised, and this course seems sound after growth and developmental possibilities have been given proper consideration. The next set of casts, one year and nine months later, shows the mandibular and maxillary central incisors in good occlusion, maxillary laterals erupting labially in fairly good occlusion, and the mandibular laterals erupting lingually with the right one slightly rotated. Also the maxillary left and the mandibular right first

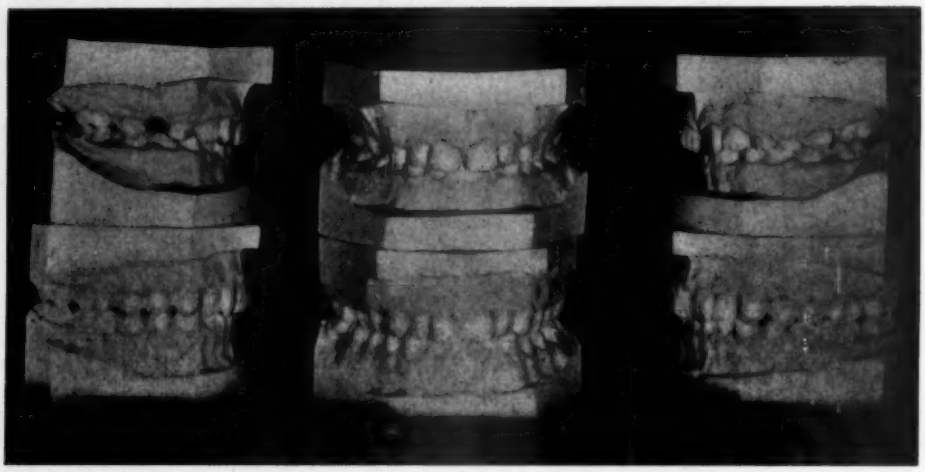


Fig. 3.

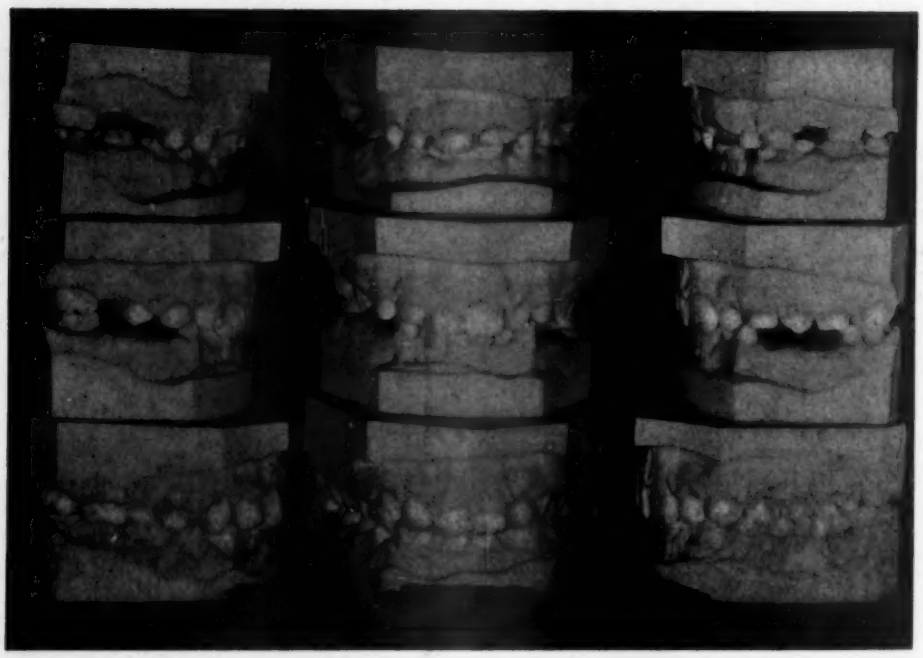


Fig. 4.

deciduous molars have been lost prematurely. The spaces showed quite a marked tendency to close and a space maintainer was placed on the mandibular right deciduous second premolar and canine. None was used on the upper left. The next set of casts shows the case four years and seven months later with quite a normal occlusion except for a deep overbite and a decided lack of space

for the mandibular right canine. The lack of space was probably partially due to a first premolar on the right side which measured considerably larger than the one on the left. The size of this tooth was decreased very carefully mesiodistally by trimming, and with a simple orthodontic appliance, consisting of a band on the mandibular right first molar with some wire spurs, the canine was moved into a satisfactory position in a very short time. The last set of casts which was made just about six years later, twelve years after the originals were made, shows the present condition which must be regarded as a satisfactory occlusion.

Fig. 3 is that of a sister of the preceding patient (Fig. 2) at 8 years of age showing a normal occlusion in the molar and premolar regions except for a partial closure of space resulting from the premature loss of the maxillary right first deciduous molar. The mandibular central incisors are in good position, but the lateral incisors are erupting lingually and the left one is rotated producing something of a mirror image of the sister at the same period of development. The maxillary incisors, however, show slight rotations with a space between the central incisors. Here again, observation was advised and the case was observed for the following six years and nine months developing the occlusion that is shown in the second set of casts which must be termed a fairly satisfactory occlusion functionally and in appearance.

Fig. 5.

Fig. 4, which is that of a brother of the last two patients at the age of 7, shows a decided lack of space for the mandibular incisors, three of which are quite well erupted, the left lateral being unerupted and with less than half of the required space, the maxillary central incisors erupting with a slight space between them and a rotation of the right one. There has been a premature loss of both maxillary right deciduous molars and the left first deciduous molar. Observation again was advised. Following this, other deciduous molars were lost prematurely, and the second set of casts shows the condition two years later. There has been a marked tendency for improvement in the incisor region. The maxillary left lateral incisor is slightly lingual to the mandibular left deciduous canine. The deciduous canine was ground to relieve this mechanical interference with labial movement of the maxillary lateral incisor. While things do not look good, they do not look entirely hopeless in the pre-

molar and canine regions where the teeth have been lost prematurely. Observation was continued and the case developed the occlusion that you see in the last set of casts which were made three years and two months later. The dentition is complete except for third molars with just a fair occlusion. The molars and premolars are in very good occlusion, but there is quite a marked crowding of the mandibular anterior teeth and a slight crowding and rotation of the maxillary right central and lateral incisors. This result is far from ideal, but it is quite satisfactory to the patient, parents, and the operator.

The end results in these last three cases, two of which were entirely observation, are nothing to be particularly proud of, but there is much more reason to be proud of these results than there would be of similar results after a year or two of treatment. After careful thought and study of the final results of cases that have been treated and also the existing conditions in good occlusions that have not been treated, one would certainly not find it wise and sound to advise treatment in these three cases as they are now.

Fig. 5 is that of a male patient at 9 years of age showing premature loss of the mandibular left second deciduous molar and the right first and second deciduous molars. Other deciduous second molars were lost prematurely soon after these casts were made. On either side the first molars seem to have drifted and tipped somewhat mesially with a partial closure of space resulting. Observation was advised and continued with the result shown in the second set of casts which was made three years and four months later. The dentition is complete except for the maxillary left second molar and third molars. The maxillary right second molar and mandibular right first premolar are not fully erupted. This occlusion must be considered one that is very satisfactory and well within the range of normal.

Observation as an aid in diagnosis has proved to some men that the amount of orthodontic treatment that seems necessary at the first examination can often be reduced or entirely eliminated. Inasmuch as this is true, observation must be employed to a greater extent if orthodontic treatment is to be put on a sound basis and if orthodontics is to assume its proper place as a health service.

REPORT OF CASE TREATED WITH THE JOHNSON TWIN-ARCH APPLIANCE

CLARE K. MADDEN, D.D.S., GREENWICH, CONN.

IN PRESENTING this case report I wish to show that the choice in treatment therapy employed was important even though the malocclusion was not so unusual. By means of the twin-wire appliance it was possible to obtain, with comparative ease and with brief time consumed, a good functional relationship and a pleasing esthetic result.

From some of the facts in the child's history, one was able to formulate a possible etiology. The patient was an American-born girl 12 years of age. She had been subjected to the usual childhood diseases but otherwise was in good health. Tonsils had been removed, and there was no indication of nasopharyngeal pathology, however, she was a habitual mouth breather. The patient's tongue and lips seemed normal in size, but the latter were malrelated except under muscular effort. It was felt that the malfunctioning facial muscles, due to mouth-breathing, and possibly some perverted muscle action on the maxillary right buccal segment were factors in the development of the anomaly.

A study of the data concerning the case was made and the diagnosis determined. An analysis of the casts and appearance of the child showed the lower dental arch and body of the mandible to be in normal relationship to the anatomy of the skull. On the right side the mandibular first molar was distal in its relation to the maxillary first molar. On the left side the mesiodistal relationship of the first permanent molars was normal. The axial inclination of the upper cuspids and premolars indicated that there had been a mesial drift of these buccal segments. (Figs. 1 to 3.)

The result of the mesial drifting was a marked labioversion of the maxillary anterior teeth and a disharmony between the median lines of the upper and lower dental arches. This lack of harmony appeared to be due to a displacement of the maxillary incisors to the left rather than to a mandibular displacement. A deep overbite was present with the mandibular incisors occluding in the palatal tissue (Fig. 4).

The photograph (Fig. 4) was taken some time before treatment was started and I advised the parent to wait until the remaining deciduous teeth were shed. The photograph shows clearly the median line discrepancy.

The plan of treatment was then outlined and the following decisions made: first, to correct the mesiodistal relationship of the first permanent molar on the right side using the mandibular arch as anchorage; second, to correct the perverted axial inclination of the buccal segments; third, to reduce the amount of labioversion of the maxillary anterior teeth and correct the median line displacement.

Read before the New York Society of Orthodontists on February 23, 1942.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

The appliance therapy that seemed most helpful was to use a lingual arch on the mandibular teeth for anchorage and the twin-wire arch and bands on the maxillary teeth (Fig. 5).

In Figs. 5 and 6 I have tried to show the construction of the Johnson twin-wire mechanism. Briefly, it consists of so-called end tubes upon which hooks may be soldered. The jig shown at the top of the chart is helpful in placing the hooks. The twin wire of 0.010 or 0.011 diameter is threaded through the end tubes and the ends are crimped. The arch is than placed in a vise, and the crimped ends are pulled into the tubes (Fig. 6)

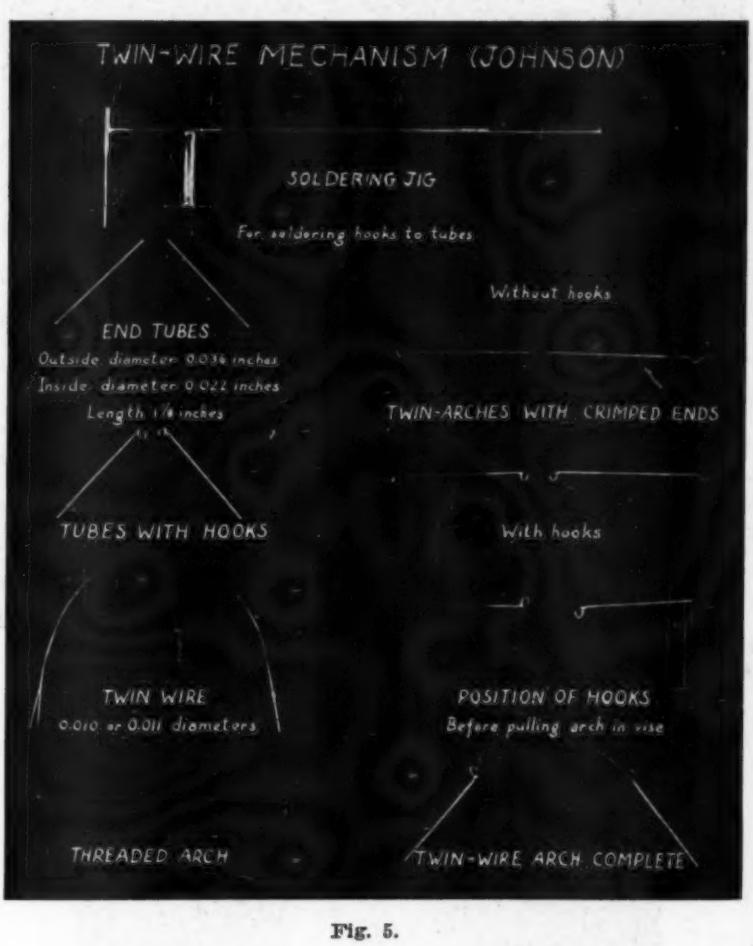


Fig. 5.

At the top of Fig. 6 are views of the mandrels for making the coil springs. On the right side, band positioning, which is most important, is shown. Stock arches with and without hooks are in the lower portion of the chart.

The following teeth were banded, the four first permanent molars and the maxillary six anteriors with the special bands used with the twin-wire mechanism. The mandibular cuspids were banded to support the lingual arch and aid in the anchorage. On the right end tube of the arch was placed a coil spring to move the right maxillary first permanent molar distally. The coil spring was then put into action by compressing the spring and pinching a stop on the end tube. Intermaxillary elastics were worn on the right side only. As soon as the molar started to move distally, the bite began to open. After the molar

relationship was corrected, the next step was started. The coil spring was removed and an upper lingual arch placed. The maxillary premolars were

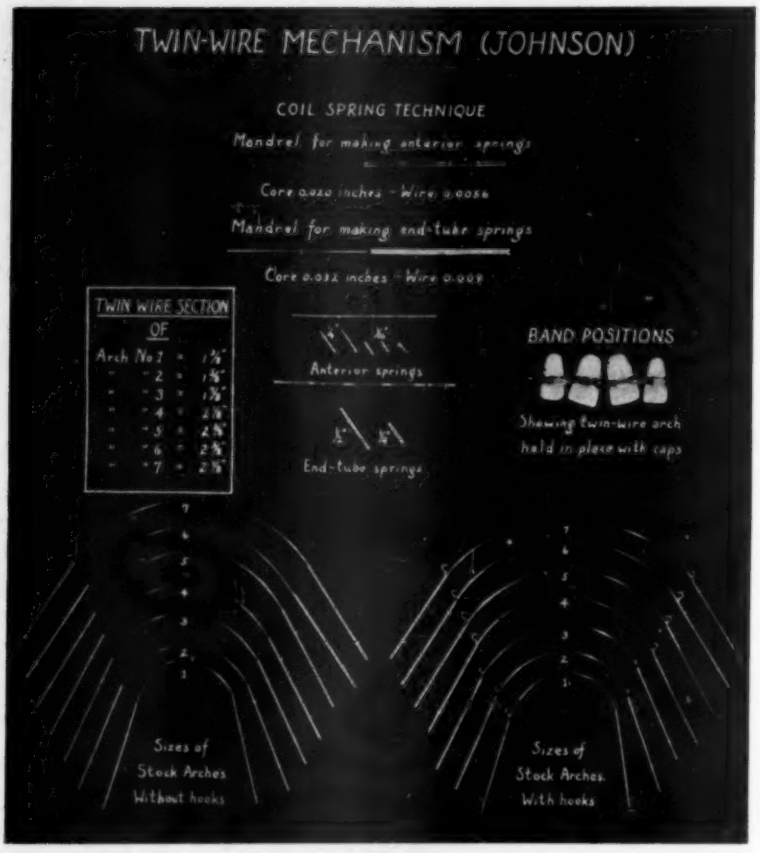

TWIN-WIRE MECHANISM (JOHNSON)
COIL SPRING TECHNIQUE
Mandrel for making anterior springs
Core 0.020 inches - Wire 0.006
Mandrel for making end-tube springs
Core 0.022 inches - Wire 0.009
TWIN WIRE SECTION OF
Arch No 1 = 1⅛"
" " 2 = 1⅛"
" " 3 = 1⅛"
" " 4 = 2⅛"
" " 5 = 2⅝"
" " 6 = 2⅝"
" " 7 = 2⅝"
Anterior springs
End-tube springs
BAND POSITIONS
Showing twin-wire arch held in place with caps
Sizes of Stock Arches Without hooks
Sizes of Stock Arches With hooks

Fig. 6.

Fig. 7.

moved distally by means of auxiliary springs on the upper lingual arch. At the same time intermaxillary rubbers were worn on both sides of the twin arch.

As soon as the protrusion of the maxillary anterior teeth was corrected, a twin-wire arch with anterior coil springs was placed. By means of these springs the maxillary anteriors were moved along the arch connecting the median line discrepancy.

Fig. 8.

Fig. 7 shows the position of the teeth a year after the appliances were removed. Please note the improvement in the median line and the amount of bite opening.

Fig. 8, a photograph of the patient smiling, is not the type usually shown for orthodontic reports; it is a means, however, of showing a rather pleasing esthetic result.

22 Lafayette Place

THE AMERICAN BOARD OF ORTHODONTICS

FREDERIC T. MURLLESS, JR., D.D.S., F.A.C.D., HARTFORD, CONN.

INSTEAD of offering you a formal report of the Board with statistics of certification and the like, I should like to use the time assigned to me to ask you to consider the Board and its activities, and to take a forward look with me. I should like to ask your opinion, rather than merely to tell you something, to speak as your fellow-member of the American Association of Orthodontists, and not in the strictest sense, officially for the Board.

So let us say, that I am asking the members of the American Association of Orthodontists here present to think what our attitude toward the Board is, and what it tends to be—if the Board seems worthy of perpetuation, and if there is anything that the Board can or should do for Orthodontics, or for the American Association of Orthodontists.

You know that Albert H. Ketcham was the moving spirit in the organization of the Board which he hoped to establish as an educational influence in orthodontics, and that for a number of years, often at the expense of physical inconvenience and suffering, he devoted much time to this purpose, desiring that the certificate of the Board should increasingly become an evidence of individual achievement, and that the prospect of the possession of the certificate should be a stimulus for personal effort in research and practice, a reward for contributions to orthodontic progress, and an evidence of personal attainment.

From the work of the Board as I have known it, and from personal acquaintance with numbers of those who have received the certificate, I have come to feel that Dr. Ketcham built even better than he knew, and that he is still an inspiration to those who knew him, and through them, to many men to whom his name is a symbol of idealism and leadership.

But men change, and customs with them, and mere tradition is not a driving force. I have been asking myself as I am asking you, what the scope and usefulness of the Board and its certificate are going to be in the future. Our answer to these questions is in the reaction of the men already certified and the record of their activities in the more recent years. Seemingly the value and satisfaction which the certificate affords is measured by every man by the effort which he has made to meet the requirements. What costs most means most, always.

Even so, one might sometimes feel that the schedule of requirements in order to be fair, should remain constant, but I believe there are few situations where general agreement would be found more tolerant of a plan in which the requirements for certification should keep along with the flow of orthodontic information and the results of research.

Apparently, however, a change in the schedule of requirements may not seem necessary, for the offerings of theses and recorded cases frequently furnish evidence that standards of procedure and observation are rapidly and automatically

Read before the New York Society of Orthodontists, Feb. 23, 1942.

advancing. It should be realized that originality is not absolutely essential as evidence of the value of a paper. Often the most useful presentations are those which create renewed interest in accepted facts, and which present fresh and convincing proofs of the essential value and usefulness of half-forgotten truths. Truths, simply presented, and obviously confirmed in the personal experience of the essayist give permanent value to a thesis, while topics should be avoided which are not closely related to orthodontics, but which belong much more to some collateral science, unless perchance the author has already received recognition for previous work from recognized authorities in that field.

As I said, one should not hesitate to make the effort to write, on account of seeming lack of something new to say. The wisdom of the ages renews its force when again said convincingly. It is interesting to think how little of the world's lore is actually new, anyway. Getting something for nothing is familiarly spoken of, and with implied reservations against the man who seems to try to do so, but it is interesting to realize that civilization itself is a system of getting something for nothing. We depend little upon our own experience, and the wisest go on from where others have left off. Much of what we know and have is a free gift from the aspirations of a thousand other generations. We invent little, but mostly we merely add vividness and a bit of polish to some old idea as we pass it along. To do this, we are bound in gratitude, for it is our only way of paying our entrance fee to the gallery of the world's experience.

If I may make a suggestion, I should like to tell you confidentially that many of our theses are not exactly literary products, and worthy ones often miss publication because their fine ideas and good strong thoughts are not well presented. After all their work, they do not get into print. I think men are sometimes disappointed about this. It has occurred to me that it may not always be understood that it is perfectly legitimate to have criticism in regard to grammar and spelling and the arrangement of the paragraphs of a thesis, particularly after ideas are assembled and the material has been checked for absolute correctness of statement and for accuracy as to sources, and in regard to such details as names, surnames, initials, etc. The choice of words in expressing an idea and the arrangement of paragraphs in a thesis is a skill all by itself. There are persons in every community and in every man's circle of acquaintances who, knowing nothing of the topic of the essay itself, are able to help dress it up and give it force and rhetorical value. By means of this sort of aid, credit may be secured for the writer where credit is due, but which would be otherwise overlooked.

A bibliography is seldom superfluous and is often quite essential to the appreciation of a paper, if and when it gives specific references to book and page of the works of an author who is quoted. But a mere list of books without these references serves no useful purpose and should be omitted.

When completed, a well-prepared thesis will deserve to be presented on choice paper, with perfect typing and paging, and a pleasing title, and to be placed inside an attractive binder. The presentability of such a thesis increases immensely the satisfaction that a man may feel in his work.

Gnathostatics is rarely, if ever, nowadays treated with open opposition and disparagement. Its place has been found, and many men consider its informa-

tion a necessary part of orthodontic data. Together with photostatic photographs, these casts furnish very reliable and convincing case histories. Gnathostatic casts are not required by the Board, but without doubt the day is near when gnathostatics will be employed habitually by all trained orthodontists.

Orthodontics has grown principally by the accrued moments of concentration that have been put into papers by men who have had valuable and conclusive experience, and who have obeyed the urge to put their convictions into words. No man who has done these things ever regrets them. Such undertakings make men acquainted with their own undiscovered abilities. Like getting gold out of the ground, it is laborious, but worth the effort. A paper is a source of pride, always, and no one can truly begrudge the effort afterward.

For one reason, only, the Board exists, to build up and support our specialty and to stimulate men to become coherent parts in it. It is educational in its purpose and confers a benefit on the science of orthodontics by its requirements, and a greater one on the applicant.

I am sure you believe with me that the Board has proved its worth, and that it serves an ever-enlarging purpose as an educational influence in orthodontics. It is to be hoped that in its maturer years it will gain even further recognition for its impersonal approach to its problems, and for its known fairness, and for its helpfulness to the individual applicant, as well as for its beneficent influence upon orthodontic history.

43 FARMINGTON AVENUE

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City.

Dietetics for the Clinician: By Milton Arlanden Bridges, M.D., F.A.C.P., Late Assistant Professor of Clinical Medicine and Lecturer in Therapeutics and Nutrition, New York Post-graduate Medical School of Columbia University, etc. Fourth edition, thoroughly revised, Octavo, 960 pages. Buckram, Price $10.00, net. Philadelphia, 1941, Lea & Febiger.

In this edition the author has substituted typical diets for the sample menus heretofore used. From these lists specific menus can readily be devised to meet individual conditions imposed by economic status, seasonable availability, cooking facilities, and other conditions. The subject of acid-base factors in nutrition is discussed in considerable length and factual data offered in a practical form for both student and clinician.

The book is divided into two parts. Part One deals with the mechanics, physiology, chemistry and other general considerations of digestion; the vitamins; and tabulations of food factors. Part Two deals with the dietetic management of diseased adults. The chapter on Oral Conditions and Diseases is contributed by Irving A. Swanson, D.M.D., Chief of the Oral Surgery Service at the Tonsil Hospital, and Assistant Instructor in Oral Hygiene at the New York Medical College, Flower and Fifth Avenue Hospitals. Swanson briefly describes the anatomy and chemistry of the dental structures and the chronology of human dentition. An attempt is made here to correlate normal diet to proper dentition. The appendix to the book covers almost 300 pages and includes height, weight and age tables and other anthropometric tables of children. Adequate low cost diets are provided as are nutritive and caloric value of various foods.

This work, which has been widely accepted since its first publication, has been steadily improved and now lists among its contributors outstanding physicians and surgeons. The dentist and orthodontist will find here a valuable reference book in practically every phase of dietetics.

J. A. S.

Theory and Treatment of Fractures of the Jaws in Peace and War: By Horace Hayman Boyle, H.D.D., and L.D.S. (R.F.P.S.) Glas., H.D.D. (R.C.S.) Edin., Late Captain, D., Army Medical Service; Dental Surgeon to the Ministry of Pensions; Consulting Dental Surgeon under the Board of Control in Lunacy to the Swansea and Merthyr Joint Mental Hospital; Tutor in Post-Graduate Dental Study for the Medical Correspondence College, London; Post-Graduate Lecturer on the Treatment of Fractures

and on Applied Dental Esthetics. With 127 illustrations, Pp. 288, Price $6.00, St. Louis. 1940, C. V. Mosby Co.

Boyle describes the elements of the anatomy and physiology of the human masticatory apparatus and reviews the theory and practice of the treatment of fractures of the jaws. A chapter is presented on the immobilization of jaw fractures with special reference to war injuries.

It is of value to note that as a result of modern methods of warfare the author has seen fit to include the treatment of fractures in children. The child patient, it was found, must be dealt with on a different basis than the adult. In the child, shock is complicated by manifestations of fright which makes it necessary to waive the usual methods of treatment in order that mental unbalance may not be further disturbed. The use of wiring appliances in the deciduous dentition is not as satisfactory as in the adult. Although the natural occlusion will suffer by the adoption of bandaging, the use of chin caps, and plaster casts of the lower third of the face, these measures must be resorted to in order to minimize gross evidence of later deformity.

A chapter on general technical considerations is provided which makes of this volume a practical treatise of value not only to the oral surgeon, but also to the general practitioner of dentistry. The book is well illustrated and written in the form of a practical manual. A detailed index is provided.

J. A. S.

A Five-Year Clinical Study of Factors Affecting First Dentition: By H. E. Thelander, M.D., *J. Pediat.* **20**: 187, February, 1942.

Instead of selecting children with and without caries and probing into their pasts for important factors, a group of infants before they had any teeth were chosen for a long-time observational study. During these five or six years pertinent data were recorded and summarized. The present analysis is based on these data. The Oak Street Health Center from which the material is drawn was started by the Child Hygiene Committee of the American Association of University Women (A.A.U.W.) for the purpose of educating foster mothers, presumably lacking the maternal instinct to care for the young, in the care of their infant wards. It now serves as an educational center for the mothers of the city, under private pediatricians and the Department of Health.

The dental examinations were made with a mirror and explorer and recorded according to the Bodecker index. In the first dentition there are twenty teeth, each tooth with five surfaces, making a total number of one hundred surfaces. Caries can therefore be expressed directly by percentages, one cavity being 1 per cent.

The final tooth analysis was made from the examination at the age nearest 6 years, placing the age for the final examinations between 5 and 6½ years. Some of the children began losing their baby teeth as early as 5 years, and others retained all of them until 6 or 6½ years. These studies did not take into consideration the time of eruption of the teeth or, therefore, the length of time of exposure to dental decay.

Some children under the most adverse circumstances continue free from caries while others with the utmost precautions will develop them. Arranged

in order of the number of cavities, there were twenty-seven children called Group A who on inspection and dental examination, as noted above, had no cavities or the filling of a small fissure only; at the other extreme were eighteen children called Group C with six or more cavities; in between were thirty-three children grouped as B, with varying degrees of caries, between one and five. After this distribution had been made the individual records previously analyzed were checked off. By adding all the adverse factors of each group and dividing by the number of children in that group, the number of adverse factors is obtained. In Group A, the noncarious group, the figure is 1.9 per child as compared with 3.66 per child in Group C. In Group B the figure is 2.4 factors per child.

It should not be forgotten that the adverse factors which have no obvious effect on the first teeth may be playing a role in the subceptibility of the second teeth to decay. The interesting individuals to note are the exceptions in each group; that is, the children with four adverse factors who have no caries and the ones with only one adverse factor who still develop rampant caries. The pediatrician will recognize this type of child as a recurrent problem in his practice.

The factors in Groups A and C showing a positive high correlations were:

1. The condition of the mothers' teeth.
2. Adverse factors in the maternal history, such as elderly mothers, ill health, etc.
3. Adverse factors during pregnancy, such as poor diet, vomiting, toxemia.
4. Adverse environmental factors, such as poverty, poor hygiene, casual care.
5. There was a high correlation between sugar intake and caries and a less marked one between the low intake of vitamins A and D and caries.

There was no correlation between childhood illnesses, nutrition as gauged by height, width, weight charts, breast feeding, or diet, per se, in the A and C groups. The attendancy at the center of the two groups was comparable.

The study suggests that the teeth, like other organs of the body, vary intrinsically within a wide range and the end results, as expressed in caries, may be dependent on many factors. With many adverse factors in operation, the best teeth may decay; conversely with the best of care, the structurally inadequate teeth may succumb to caries. The first teeth are more influenced by prenatal factors than postnatal ones, and of the postnatal factors excessive sweets and lack of vitamins A and D probably are the most important recorded in this study.

This study warns emphatically against the use of loosely constructed human control experiments. Where multiple factors are involved, most of which are beyond control, the result from controlling one factor is masked by the influences of the uncontrolled factors. For example, if these 78 children had been divided into two groups at the beginning of the study and one-half given cod-liver oil and the other one-half none, the results would almost certainly have been negative or the variations would have been so slight that conclusions drawn would be subject to grave doubt. The natural variations offset the ex-

perimental constants. In an individual case, however, the cod-liver oil may be the important factor. In most types of human studies, however, the variations in race, size, age, heredity, environment, habits, and will power summed up will mask the expected results in individual cases. Negative results obtained in such a study should not and cannot logically be used as positive proof against the value of a given factor in an individual case. The clinician can well afford to observe carefully, weigh honestly, and draw some of his own conclusions on individuals under his care and also view more critically statistical studies and experimental results that come out of laboratories based too often on animal experiments and interpreted for humans on such a basis.

J. A. S.

Fundamentals of Comparative Embryology of the Vertebrates: By Alfred F. Huettner, Associate Professor of Biology, Queens College, Flushing, N. Y., Pp. 416, Price $4.50, New York, 1941, Macmillan Company.

This volume deals with elementary comparative embryology from the morphologic point of view. Embryologic research entered into an entirely new period after Schleiden and Schwann formulated a cell theory. However, Balfour is credited with being the founder of modern comparative embryology. In this volume the author discusses cell and sex development and the embryology of various vertebrates leading up to the mammals. The chapter on human development is devoted to the fundamental phases and does not enter into the specific development of tissues, organs, and organ systems. However, the reader desiring a topical account of the basic factors of human development will find here much valuable information.

The book contains many valuable diagrammatic original illustrations which aid greatly in the understanding of the text.

J. A. S.

Preventive Treatment to Avoid Dental Malocclusion: By Dr. Jose J. Rojo, President of the Mexican National Dental Federation correspondent of the FDI., Ex-Professor, Founder of the Class of Orthodontia and Ex-Dean of the Odontology School of the National University of Mexico at the Third International Assembly of Surgeons, Mexico. August 10 to August 14, 1941. *Revista Odontologica de Mexico* **13**: 10-15, 1941. (Digested.)

I think that a tenacious and extensive campaign must be undertaken all over the world, so that the hygienists, the governments, and the teachers give better and greater attention to the study and care of deciduous teeth, and if we care at an early age for the deciduous teeth, we will make it possible for thousands and thousands of permanent teeth to erupt normally and as far as it is humanly possible, to prevent the syndromes of dental malocclusion.

The epoch has passed into history when it was necessary to speak of the necessity of establishing in dental schools autonomous courses in orthodontics; likewise the epoch is over for justifying the investment necessary in orthodontics. Nowadays, everybody recognizes the great necessity in relation to the benefit that it renders. Let us not say only esthetic, to prevent physical and complex inferiority, but to prevent gingival diseases and caries, as well as to accomplish the fulfillment of the great functions, i.e., masticatory, respiratory,

of diction, and consequently as the most important, to normalize the anatomic structure of the dental arches and of the maxillary bones and their beneficial actions in the mastication and respiration that, in general, will improve the organism, and permit it to reach the adult age with normal development and health.

I think I can see as clear as day and I ask that other orthodontists confirm or refute it, that in carefully examining the deciduous teeth there may clearly be found the forthcoming anomalies of position of permanent teeth. Therefore, as a natural sequence, I urge preventive treatment recognized in this work.

With the purpose of having this idea realized, hereinafter, I express the following resolutions:

1. That the deciduous teeth of children be inspected from the first to the fourteenth year of age, every six months.

   a. From the general health point of view.
   b. From the orthodontic point of view.

2. To practice orthodontic preventive treatments on the deciduous teeth, at about the age of six years.

Orthodontic Problems: By Harold J. Noyes, D.D.S., M.D., *J. Pediat.* **20**: 503-506, 1942.

The teeth represent relatively mobile units receiving pressure influence from their neighbors in the same jaw, their antagonists in the complementary denture, and the soft tissues about them. Through the periodontal membrane, these pressures are reflected upon the supporting alveolar bone which makes response depending upon the nature of the impulse, altering its structure to permit the teeth to resist the strain or decrease it by changing their position. This extremely important property of the alveolar bone contributes to normal facial growth and to the continual adjustment of the teeth to their complex environment. Under less favorable circumstances it permits the teeth to move into malocclusion when unable to resist abnormal pressures and to compensate for defective underlying osseous structure. Likewise, it is the means of their response to orthodontic appliances.

There is general agreement that the degree of adaptation in the following sites is in the order named: alveolar bone, temporomandibular joint, and bony base of mandible and maxilla. Deformities limited to the teeth and alveolar bone include disturbance in the normal balance of the forces upon the teeth (for example, habits, loss of dental units, abnormal form or size of dental units, accidents in eruption, and occasionally, abnormal position or orientation of tooth follicles). When the cause is no longer active or can be eradicated, they offer the most hopeful prognosis, because the orthodontist is able to exert his greatest influence upon the alveolar bone.

When the deformity is primarily within the body of the maxilla or in the body or ramus of the mandible, the possibility of attainment of complete facial growth is less likely. The alveolar bone and temporomandibular joint permit of certain elasticity in compensating for defective growth in the bony bases. This is true in unassisted cases as well as in those treated by the orthodontist. However, even these tissues have their limits, and prognosis must be governed by the severity of the deformity and the limits of the reactivity of the alveolar

bone, glenoid fossae, condylar heads, and perhaps the remaining growth increment of maxilla and mandible. Optimum rather than average health may mean the difference between success or failure in treatment in many patients within this group.

Orthodontic problems within the cranial base are less frequent. It appears that the arrest is earlier in the developmental history of the individual and possibilities of restitution within the affected bones less likely. The effect of these deformities may be reflected in maxilla and mandible and commonly in alveolar bones and temporomandibular joint. Orthodontic problems are more than straightening teeth and explaining why in cases of the first group a few months of treatment may effect a satisfactory and enduring result, while other periodic applications of therapy may only diminish and not eliminate the defect.

The parent may become reconciled to imperfection in stature, posture, or even latitude in weight. He will tolerate less than the greatest achievement in muscular development, and excuse a certain lack of perfection in organic function, but because the face is to such an important degree the avenue of expression and the center of attention in social contact, he desires perfection there. We can do a very credible job of nourishing children and adults with marked imperfections in jaw and dental structure, but we cannot give them perfect faces without the assistance of these tissues.

Textbook of General Surgery: By Warren H. Cole, M.D., F.A.C.S., Professor and Head of the Department of Surgery, University of Illinois College of Medicine; Surgeon, Illinois Research Hospital, Chicago, and Robert Elman, M.D., Associate Professor of Clinical Surgery, Washington University School of Medicine; Assistant Surgeon, Barnes Hospital; Associate Surgeon, St. Louis Children's Hospital; Director of Surgical Service, H. G. Phillips Hospital, St. Louis. Third edition, pp. 1067. Price $8.00. New York, D. Appleton-Century Company, 1941.

The present edition (the third) represents an entirely new revision in keeping with the general trend in medical science. The subject matter is presented as far as possible from the physiologic point of view. Surgical pathology is stressed and numerous photomicrographs and illustrations of gross specimens, as well as case histories, are presented. Particular attention has been devoted to war surgery, especially to open wounds and burns. Shock is discussed from the clinical and pathogenic aspects. The effective use of sulfanilamide compounds in accidental wounds and abdominal operations is discussed in detail.

Dentists and oral surgeons will find the parts on surgical treatment of the various conditions such as Vincent's and Ludwig's anginas, anthrax, and other conditions about the face and jaws of practical value, as well as the chapter on general and local anesthesia. The surgical technique of treating open wounds about the face is discussed and fully illustrated.

An interesting chapter is the one on "The Emergency Prostrate Patient: Coma, Unconsciousness, Delirium and Convulsions." Cysts of the jaws are discussed and the various techniques described. The book is profusely illustrated and contains a wealth of references and a detailed index.

J. A. S.

Editorial

The Call for Physicians and Dentists

According to recent information secured, more than 3,000 physicians moved into the armed forces during the six months since Pearl Harbor. It is estimated that another 40,000 are needed between now and the end of 1942, also that two-thirds of the 72,000 physicians of 44 years of age or under will see service before the war is ended.

There obviously are two important problems to the situation. One is the filling of the needs of the services; the other is spreading the supply so that the nation as a whole can be served. The problem is to be dealt with on a voluntary basis if possible. It is to be met by a system of rationing.

This system applies to physicians and dentists alike. It is built around the Procurement and Assignment Service, as a branch of the War Man Power Commission, and is administered by men from the profession. The shortage problem, however, centers in physicians and is far less acute in the case of dentists.

All assignments are on a voluntary basis. There is no power to order a man to pull up stakes and enter the Army, or to move from a practice in one community to service in another community where the man may have gone into the Army. However, this is a very potent indirect power in the fact that the Assignment Service can recommend to Selective Service Boards that physicians and dentists who are physically and professionally qualified be inducted into the services.

The man who volunteers for military service is given a commission. This is in sharp contrast to the reception of other professional men who can be inducted as privates at $50 a month. The man who does not volunteer, after urging by the Assignment Service, may be drafted as a private.

Mr. Paul V. McNutt, Chairman of the Man Power Commission indicates that no interference with accepted practices, no experiments in state medicine are contemplated. Creation of the Procurement and Assignment Service, he says, "does not involve any theoretical assaults upon, nor support of, any theory of medical practice." He assures the professions that the Service will be discontinued after the war.

The Army has recently sent out a call for 3,000 dentists to be secured by July. In the event the desired number is not secured, it is reasonable to suppose that some other way may be devised of securing the quota. In the case of the physicians at least, Mr. McNutt has warned that "some other more vigorous plan" will be used, if physicians do not respond to the call of the volunteers.

The Dental Corps has become a highly important branch of the medical division of the armed forces and now since the Procurement and Assignment Service of the Federal Security Agency, operating in every state, is finally in

operation, a dentist, before he can be commissioned must obtain certification from the chairman of that service as available for military service.

From indications revealed by the response up to the present it is reasonable to suppose that the response of the dental profession will be sufficient to meet the requirements as outlined in the recent call from the War Department. It is believed that the patriotism of the dental profession will be found in this emergency to equal that of any other group of American citizens as indicated by their willingness to serve in the capacity for which they are most useful.

H. C. P.

Announcement

The following notice has just been received from the American Dental Association:

"By action of the Board of Trustees of the American Dental Association, the Eighty-Fourth Annual session scheduled for Boston has been postponed. In its place will be held a meeting of the Board of Trustee's House of Delegates and standing committees at St. Louis, Mo., during the week of August 24 to 28."

Special Feature

Preliminary Remarks

The creation of the Albert H. Ketcham Memorial was suggested by Dr. B. Frank Gray at the first meeting of the American Board of Orthodontics after the passing on of our distinguished friend, whose life work had contributed so generously to orthodontics. The Ketcham Memorial was established by the American Board of Orthodontics in collaboration with the American Association of Orthodontists in 1936, in order to commemorate Dr. Ketcham's achievements and to serve as an inspiration to the advancement of orthodontics.

A fund to finance the Memorial was raised by voluntary subscriptions of the members of the American Association of Orthodontists.

The committee which selects the recipient of the Award is made up of three members of the American Association of Orthodontists (namely, the President, President-Elect, and Vice-President) and two members appointed by the American Board of Orthodontics, who are also members of the American Association of Orthodontists. So, each year, the person who receives the Albert H. Ketcham Award is the choice of the members of the American Association of Orthodontists, chosen by your representatives.

PRESENTATION OF THE ALBERT H. KETCHAM MEMORIAL AWARD, 1942, BY CHARLES R. BAKER

It is a real pleasure to announce the recipient of the 1942 Albert H. Ketcham Memorial Award. He is one whom we all love and respect—our good friend Dr. Harry E. Kelsey.

Harry Estes Kelsey was born July 9, 1872, the son of Samuel Truman Kelsey and Katherine Ricksecker Kelsey, at Pomona, Kansas. In 1874 the Kelsey family moved to Macon County, North Carolina, where Dr. Kelsey's father established the Health and Summer Resort of Highlands, and subsequently organized a company which developed Linville, a summer resort in Mitchell County, North Carolina.

Harry Kelsey received his early education in the public schools and under private tutors. He was graduated from the Baltimore College of Dental Surgery in 1896. He immediately entered upon the general practice of dentistry and was appointed Demonstrator in the clinic of the Baltimore College of Dental Surgery.

In 1903 Dr. Kelsey was married to Miss Eva Pauline Hamill, daughter of George W. Hamill, M.D., and Blanche Grove Hamill. The Kelseys spend the summer months at Sherwood Forest on the Severn River and reside in Baltimore during the winter months.

Early in his orthodontic efforts, Dr. Kelsey associated himself with the late Dr. E. A. Bogue of New York City and through that connection, he became acquainted with many of the older generation of practitioners of dentistry who were seriously interested in orthodontics. Through their influence, interest, and kindness the young Dr. Kelsey was to profit, and to carry over to the young men later to be associated with him and to the students to whom he lectured, a kindly and inspiring influence which will not soon be forgotten by those fortunate enough to know him.

In 1906 he became a Lecturer in Orthodontics at the Baltimore College of Dental Surgery, continuing until 1910.

In 1908 Dr. Kelsey attended the course at the Angle School of Orthodontia, located at Seventy-Second Street and Broadway in New York City. It is interesting to note that four men who were classmates at the Angle School, namely, John V. Mershon, Milo Hellman, Frederick B. Noyes, and Harry E. Kelsey, have received the Ketcham Award. Their close friendship has continued throughout the years.

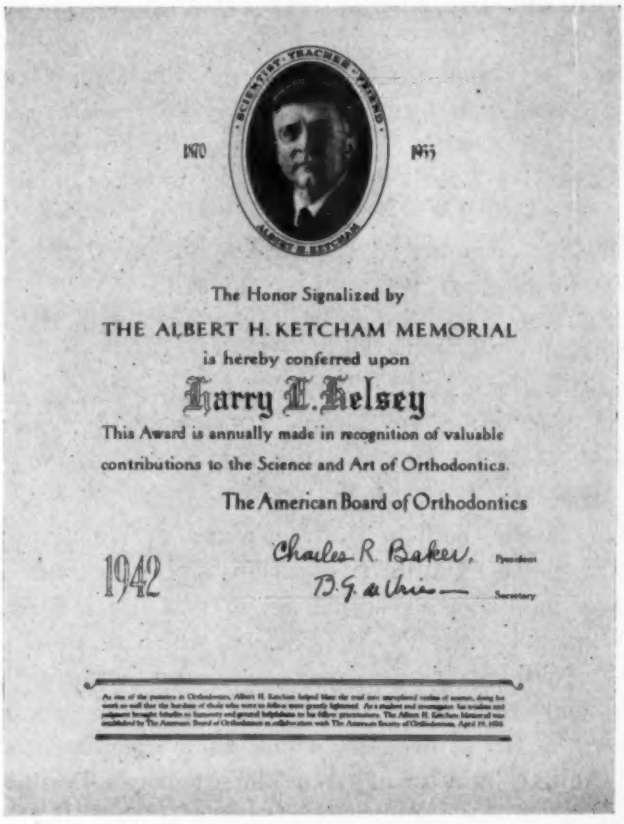
Dr. Hellman writes that he has discovered the secret of how to capture the Ketcham Award. "It's all in the food you eat." Speaking of the days at the Angle School, he says, "All of us worked from nine to six o'clock like nobody's business. But, one o'clock was lunch time. The four of us, John, Fred, Harry, and I, used to sneak out and walk down to Childs' restaurant. The universal and perennial lunch consisted of boiled rice and half and half—not the Canadian kind—just half milk and half cream." He concludes with "Good boy, Harry, and three cheers for boiled rice and half and half."

Dr. Mershon writes of the following incident: "When it came time for graduation, the boys wanted to present their teacher with a gift. We decided on a pipe. I did not smoke. Fred Noyes smoked nothing but strong 'boiler-maker' cigars. Harry was a pipe smoker, and he said that his father knew a man in New York who made pipes. So, on a Saturday, Harry (Kelsey), Fred (Noyes), and John (Mershon) started on a search for a pipe. We went from 72nd Street and Broadway to the south end of Manhattan, looking, searching, and discussing the merits of pipes, and finally, after walking seven and three-fourths miles, over to the east side and climbing five flights of stairs in search of the pipe maker Harry had recommended, with the idea of finding something especially suited to the occasion, we found the place CLOSED. I think that a pipe was purchased and presented at the proper time."

Dr. Mershon adds a personal characteristic: "You can always count on Harry catching a train but never more than three seconds ahead of time. We couldn't speak of him as 'the late Dr. Kelsey' but as 'the Harry Kelsey who was never more than in time.' "

Dr. Mershon claims to have initiated Harry into playing golf, and Dr. Joe Eby reports that Harry made one of the longest golf shots in history. It happened on the course at the Baltimore Country Club at a hole which was a blind T shot and had to be carried over a street-car track. It seems that Harry shot his ball through a street-car window and before it stopped rolling and was picked up, the car was at the end of the line.

Returning to Baltimore, after taking the Angle course, Doctor Kelsey immediately limited his practice to orthodontics, and in 1910 became Professor of Orthodontics at the Baltimore College of Dental Surgery, continuing in that position until 1923, when the college merged with the Dental Department of the University of Maryland. In 1913 Doctor Kelsey became one of the original members of the Dental staff of the Johns Hopkins Hospital, in charge of orthodontics, and continued therein until his retirement from practice in 1941, being succeeded by his first associate, Dr. George M. Anderson. At that time he was made Consultant in Orthodontics.


1870
1933
The Honor Signalized by
THE ALBERT H. KETCHAM MEMORIAL
is hereby conferred upon
Harry E. Kelsey
This Award is annually made in recognition of valuable
contributions to the Science and Art of Orthodontics.
The American Board of Orthodontics
1942
Charles R. Baker, President
B. G. Chris— Secretary

The Ketcham Award

Doctor Kelsey has always been deeply interested in helping and teaching the younger men. Five present-day orthodontists owe their orthodontic training to their association with him during their first years in the specialty. He was an unusually kind and thorough mentor, as is attested by the very high esteem in which he is held by those who have worked with him. These five former associates created an Award in the University of Maryland Dental School in 1937, known as "The Harry E. Kelsey Award for Professional Demeanor," and each year a ring, suitably inscribed, is awarded to the student in the graduating class who is most deserving of this honor. This Award is highly prized by the recipients and much sought after by aspiring students.

Dr. George M. Anderson states that "in Baltimore we feel that Doctor Kelsey has been the ideal type of professional man, with an attitude toward his profession and the public which could well serve as an example for the student and recent graduate."

For twenty years, beginning in 1913, Doctor Kelsey took care of jaw fracture cases at the Johns Hopkins Hospital Clinic. During this time he developed a splint, which has been shown in clinics and has been published in the journals.

Doctor Kelsey and Doctor Ketcham were close personal friends, and they spent many nights in conference, working and preparing plans for the organization and operation of the American Board of Orthodontics. They were also companions on many hunting and fishing expeditions.

Doctor Kelsey served as a Director of The American Board of Orthodontics and for three years was the presiding officer. He was particularly well fitted for this position, and it was with genuine regret that we had to give him up when his term of office expired.

Doctor Kelsey has been a member of the Research Commission of The American Dental Association for the past thirty years, serving one year (1934-1935) as Secretary, and for the past ten years or more he has been an active member of the Executive Board and one of the most valuable members of the Commission.

Doctor Kelsey is a member of the Brown Memorial Presbyterian Church. In politics he may be classified as an Independent.

During World War I he rendered valuable service in the examination and treatment of soldiers.

His clubs have been: University, Johns Hopkins, Baltimore Country, Baltimore Athletic, Rolling Road, Hillendale, Gibson Island, and The City Club. He is a former member of the Baltimore Association of Commerce, and for years took an active part in the Amateur Athletic life of the city and state, serving as an official of many meets, both in Baltimore and in Washington, and one term as President of the South Atlantic Association of the Amateur Athletic Union.

Doctor Kelsey has been a member since 1931 and is a past vice-president of The Henry Watson Children's Aid Society, which served the city and Community Fund as a child welfare agency and is an important member of The Association of Social Agencies. He was very active in organizing the swine feeding experiment at Beltsville, Md., which was carried on under the direction of Dr. E. V. McCollum, by a grant from The American Dental Association and the financial support of the members of the dental staff of the Johns Hopkins Hospital, where investigations of the skulls and teeth were made by Henry Klein, D.D.S. Also at Johns Hopkins Hospital, under grant from The American Dental Association, supplemented by donations from Mrs. Cone, a patient of H. H. Street, D.D.S., he participated in the research in rickets experiment, under the direction of David Shelling, M.D., and George M. Anderson, D.D.S.

Doctor Kelsey is a member of the Baltimore City Dental Society, Baltimore Association of Dental Surgeons, American Dental Association, a Fellow of the American College of Dentists, member and Past-President of the Maryland State Dental Association, American Association of Orthodontists, New York Society of Orthodontists, Washington-Baltimore Society of Orthodontists, the Dental Alumni Association of the University of Maryland, and is an Honorary member of the Southern Society of Orthodontists, the Virginia State Dental Association, and the Southwestern Society of Orthodontists. He was a member of the organization committee and Chairman of International Relations for the

Dental Centenary Celebration held in Baltimore in March, 1940. He is a former Chairman of the Board of Trustees of the Clarence J. Grieves Library Foundation of the Maryland State Dental Association, established at the Baltimore College of Dental Surgery.

During Doctor Kelsey's incumbency as President, in 1928, of the Southern Society of Orthodontists, the annual meeting was held in Baltimore and a testimonial dinner was tendered him by the Baltimore City Dental Society. A beautiful watch was presented to Doctor Kelsey and was inscribed as follows: "To Dr. Harry E. Kelsey by the Baltimore City Dental Society in appreciation of his contributions to dentistry, 1928."

Doctor Kelsey has been a steady and liberal contributor to the professional literature. Our journals have carried more than fifty scientific papers written by Doctor Kelsey, the first of which appeared in 1899. He has also had published probably more than one hundred comprehensive discussions. He has always contributed generously as a clinician. A review of the titles of his manuscripts, which are too numerous to mention at this time, is an indication of his broad knowledge and appreciation of the many problems involved in our specialty. The exceptional progress of orthodontics during the past forty years is due to the work of men like our own Harry Kelsey.

It is not necessary for one to speak of Dr. Kelsey's everyday life and those qualities which have made him a respected member of the profession and of the community in which he resides. Neither is there any need to amplify the accomplishments and personal qualifications which have endeared him to and earned for him the respect of those in distant points. Suffice it to say that Doctor Kelsey is one of those rare persons who has received the plaudits and admiration of his home folks and the recognition of his confreres in his chosen profession in all parts of the world. Probably the finest tribute that can be paid to Doctor Kelsey is summed up in the words which a young orthodontist who knows him unusually well said: "I trust and hope that as I come to the late years of my professional life, I shall be as respected, admired, and yes, even envied, as has been Doctor Kelsey."

This Award, Doctor Kelsey, is an expression of our high esteem and respect for you and of our deep appreciation of your many contributions to our specialty.

RESPONSE BY DR. HARRY E. KELSEY TO THE PRESENTATION OF THE ALBERT H. KETCHAM MEMORIAL AWARD

Mr. President, Dr. Baker, Members of the American Board of Orthodontics and of the American Association of Orthodontists:

It was my good fortune to be born in 1872—a date that synchronized my professional life with the period of greatest technical and scientific development in our specialty. For some reason, as a boy, I always expected to enter one of the professions and was greatly influenced in my choice by some beautiful dental restorations done by the late Dr. Richards of Knoxville for my mother. A rather constructive and mechanical turn of mind may also have influenced me in my choice of a profession. Dentistry seemed to me so definite in its benefits when compared with other branches of the healing art. Having adopted it, I threw myself into its support and development with all the enthusiasm of a rather one-

track mind. If I have aided in its advancement even to a slight degree, I am more than repaid for a lifetime of truly joyous devotion to it.

But I am not here to speak of my small achievements, but to try to express my appreciation for this honor you are bestowing on me and acknowledge my indebtedness to my profession and to the almost countless members of it who permit me to call them "friends." When I attempt to do this I find (as so often is the case) that words are inadequate. Yet if my confreres and friends have felt that they wanted to give me this exceptional honor as well as others in the past that have brightened and encouraged my professional life, I feel that they will accept my statement, although poorly expressed, that I do most sincerely thank not only the committee but all of you for the confidence and esteem which inspired you to make me the recipient this year of the Ketcham award and for other equally unmerited honors you have seen fit to bestow upon me in the past.

As one begins to realize that he is entering the later brackets of his life's career where he can look back and make an appraisal of it, he naturally attempts to determine in his own mind what phase of it contributes most to his own satisfaction; what part of it, if any, he would not change if he could. In doing this I think I may say without egotism that there is at least one that I would not change. I refer to the cordial goodwill and friendship which through more than forty years has been accorded me by those members of my profession with whom I have come in contact, even those who enjoyed a national and international reputation in their chosen field by virtue of natural endowments and incessant application and study. To put it another way, I would not change any part of my life even though I were promised a career marked by really brilliant achievement, if I had to give up my friends. Among them have been those much older than I, many of whom have passed away. If I am deserving even to a slight degree of this honor you are conferring on me, I must attribute it largely to the influence exercised by them and to other environmental influences at the outset, and indeed throughout, my career. I refer to such men as Dr. Richard B. Winder, dean during my first year at the Baltimore College of Dental Surgery, a gentleman of the old school, and my teacher and lifelong friend, Dr. George E. Hardy, and to the traditions of the old college. Later to my association with Dr. E. A. Bogue of New York and my good fortune in meeting a number of the other outstanding pioneers in orthodontics; and notably to Dr. Angle, his school of orthodontics and the group of now internationally known orthodontists who began their careers during the decade that succeeded the organization of the American Society of Orthodontists. But there have also been many friends much younger than I, and this latter association has done much to keep me young in spirit and quite unaware of the fact that it could not also keep me young in years, which is as much as to say that I have enjoyed life, and so I have; no one more so. I gratefully acknowledge my professional obligation to them, also, as well as to every member of this society, beginning with the president, Claude Wood, whose friendship I value so highly and whose career I have watched with such interest, he being one of that previously mentioned host of younger friends who have kept me feeling young.

To all of my former associates on the American Board of Orthodontics, I owe much, and I wish to extend my sincere thanks for the cordial relationships I enjoyed and the splendid support given me during the time of my presidency. I know I am safe in saying that Dr. Baker has had a continuation of that support and that it will be extended to his successor.

Harry E. Kelsey

I had hoped to be brief, but I cannot let this, to me, important occasion pass without sharing the honor with and acknowledging my debt to the secretaries, assistants, and technicians, who have borne with me for the last thirty years, and without whose patient help and cooperation, none of us could carry on. And particularly to that group of five associates who have been with me successively since 1919, each one patiently sharing the daily professional grind made up of hard work and discouragements but happily also occasional triumphs as meted out to an often irascible old practitioner. Drs. George M. Anderson, Gerard A. Devlin, Kyrle W. Preis, Ralph W. Hodges, and Hammond L. Johnston, who came with me after training for several years with my first associate, George Anderson, and who succeeded me in practice. He is now a member of the Johns Hopkins Medical Unit and will be called any day to active army service, and so George Anderson (whose office is next door) and I are in turn succeeding him

until his return from what we all pray God will be America's early and complete victory. I am proud of this group but need not expand on their qualities and achievements as these are already well known. Any credit I might be tempted to take for their success is due to the fact that I believe myself to be a good picker. That a cordial, personal, and professional relationship has survived our intimate association is evidenced by the fact that they have established in my name at my Alma Mater, an annual graduation award. Nothing in my professional life gives me more satisfaction than this evidence of their regard and esteem and I also look on their action as one of the highest honors ever paid me.

To indulge again the retrospective inclination so apt to be aroused on such an occasion as this, I am led to think of my little boyhood days when I was allowed to make a call on some playmate. The duration of the call was always limited and upon my arrival I told my friend's mother, or other responsible person, when I must "go home." Then with no further responsibility I threw myself wholeheartedly into the enjoyment of my visit. When informed that the time for departure had arrived, perhaps in the midst of some interesting game, there may have been a momentary regret, but as there was no appeal and I might already have been tired, my mind turned to the quieter joys of home, dinner, and rest, and so I was usually able to leave in a cheerful frame of mind. Does this not symbolize in a way a whole lifetime? We are allotted a brief visit here with a timekeeper to tell us when we must depart. If, putting from our minds the time of leave taking, we throw ourselves into the game of life with enthusiasm and give freely to those about us of whatever powers and talents we may possess, our visit here will be a wonderful experience and when the time of departure comes, it will, if we are fortunate, find us having a good time but willing to go to the rest we shall have earned.

Surely one of the best examples of the truth of what I have just said was the life of Albert Ketcham, the man in whose honor this memorial award is given. In spite of physical handicaps, which alone would have stopped many a stronger man, he went on to build one of the outstanding careers in his chosen field. I can think of no one who threw himself into the game of life with more zest and enjoyment and certainly no one who contributed more to it. I do not believe he ever consciously pursued a career; he just went on from day to day and from year to year working with the utmost concentration during work time and playing in the same way during play time, always happiest when friends were working or playing with him. He gave to them and to his patients unstintingly of the best that was in him and as a result the career took care of itself. I shall never forget the hunting and fishing trips I had with him, the last as guests of Dr. Clint Howard at his shooting club in Louisiana. "Ketch," as we often affectionately called him, was on crutches at the time, but ignoring his handicap, as was his life's habit, he accounted for his full share of ducks and had as good a time as any of us. Was there ever such a man? To be a recipient of the Ketcham Memorial Award, as you have made me today, I count the highest honor of my professional career, and in accepting it I extend again my heartfelt appreciation and thanks to all concerned.

News and Notes

In reference to an editorial "Dentists in the Draft" which appeared in the May, 1942, issue of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY, Col. L. G. Rowntree, Chief of the Medical Division of the Selective Service System, has this to say in a letter recently received:

> For the information of your readers, National Headquarters of Selective Service, under date of January 28, 1942, issued Memorandum I-363, calling to the attention of local boards the service offered by the Procurement and Assignment Service. The memorandum was designed to accomplish exactly what your editorial states should be done.
>
> Selective Service local boards are classifying dentists in Class I-A who have been cleared by Procurement and Assignment and declared available for the armed forces (and therefore not essential to their communities). This declaration is made to the local board by the State Dental Chairman of the Procurement and Assignment Service.
>
> The Selective Training and Service Act of 1940 by the Congress of the United States does not exempt physicians, dentists, or veterinarians from military service nor does it specify that these citizens shall receive commissions in the armed forces. Unless the Act is amended by Congress to provide exception for special groups of citizens, Selective Service can do no more than to issue the recommendations for the consideration of local boards that because of the shortage of physicians, dentists, and veterinarians, such professional men should be considered for deferment by said local boards when denied commissions by the armed forces.

Announcement to Dentists

The following telegram has been received from Lieutenant Colonel Seeley, Executive Officer of the Procurement and Assignment Service, under date of June 6, 1942:

> Use every means to publicize by scientific or lay press immediate need for several thousand dentists under the age of 38 for immediate duty in the Dental Corps of the Army. Those over 38 who are in Class 1-A Selective Service should also apply. Instruct them to contact their state chairmen Procurement and Assignment immediately who will cause their names to be placed before Army recruiting boards in every state. All in the above age group who have indicated Army first choice on enrollment form are hereby officially asked to apply for commissions.

Of interest to orthodontists is the fact that a probate court on the Eastern Seaboard has recently rendered a judgment holding that the husband is responsible for orthodontic services rendered to his children, even though the parents are divorced.

Note of Interest

Dr. Ross F. Bleiker, 333 Metropolitan Building, St. Louis, Mo., instructor in exodontia at St. Louis University, announces that commencing June 15, 1942, he will devote his entire time to the private practice of exodontia.

OFFICERS OF ORTHODONTIC SOCIETIES*

American Association of Orthodontists

President, J. A. Burrill _ _ _ _ _ _ _ _ _ _ _ 25 East Washington St., Chicago, Ill.
Secretary-Treasurer, Max E. Ernst _ _ _ 1250 Lowry Medical Arts Bldg., St. Paul, Minn.
Public Relations Bureau Director, Dwight Anderson
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ 292 Madison Ave., New York, N. Y.

Central Association of Orthodontists

President, Harold J. Noyes _ _ _ _ _ _ _ _ _ 55 E. Washington St., Chicago, Ill.
Secretary-Treasurer, L. B. Higley _ _ _ _ _ _ _ 705 Summit Ave., Iowa City, Iowa

Great Lakes Society of Orthodontists

President, Henry D. Cossitt _ _ _ _ _ _ _ _ _ _ 942 Nicholas Bldg., Toledo, Ohio
Secretary-Treasurer, C. Edward Martinek _ _ _ _ _ 661 Fisher Bldg., Detroit, Mich.

New York Society of Orthodontists

President, E. Santley Butler _ _ _ _ _ _ _ _ 55 Locust Ave., New Rochelle, N. Y.
Secretary-Treasurer, Norman L. Hillyer _ _ _ _ Professional Bldg., Hempstead, N. Y.

Pacific Coast Society of Orthodontists

President, Ben L. Reese _ _ _ _ _ _ _ _ _ _ _ Roosevelt Bldg., Los Angeles, Calif.
Secretary-Treasurer, Earl F. Lussier _ _ _ _ _ 450 Sutter St., San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, George H. Siersma _ _ _ _ _ _ _ _ _ 1232 Republic Bldg., Denver, Colo.
Secretary-Treasurer, Curtis L. Benight _ _ _ _ _ 1001 Republic Bldg., Denver, Colo.

Southern Society of Orthodontists

President, W. P. Wood, Jr. _ _ _ _ _ _ _ _ _ _ 442 W. Lafayette St., Tampa, Fla.
Secretary-Treasurer, E. C. Lunsford _ _ _ _ _ _ 2742 Biscayne Blvd., Miami, Fla.

Southwestern Society of Orthodontists

President, E. Forris Woodring _ _ _ _ _ _ _ _ _ Medical Arts Bldg., Tulsa, Okla.
Secretary-Treasurer, R. E. Olson _ _ _ _ _ _ Union Nat'l Bank Bldg., Wichita, Kan.

American Board of Orthodontics

President, William E. Flesher _ _ _ _ _ 806 Medical Arts Bldg., Oklahoma City, Okla.
Vice-President, Frederic T. Murlless, Jr. _ _ _ _ 43 Farmington Ave., Hartford, Conn.
Secretary, Bernard G. deVries _ _ _ _ _ _ _ Medical Arts Bldg., Minneapolis, Minn.
Treasurer, Oliver W. White _ _ _ _ _ _ _ _ 213 David Whitney Bldg., Detroit, Mich.
James D. McCoy _ _ _ _ _ _ _ _ 3839 Wilshire Blvd., Los Angeles, Calif.
Joseph D. Eby _ _ _ _ _ _ _ _ _ 121 E. 60th St., New York, N. Y.
Claude R. Wood _ _ _ _ _ _ _ _ Medical Arts Bldg., Knoxville, Tenn.

Harvard Society of Orthodontists

President, Harold J. Nice _ _ _ _ _ _ _ _ _ 475 Commonwealth Ave., Boston, Mass.
Secretary-Treasurer, Edward I. Silver _ _ _ _ _ _ _ 80 Boylston St., Boston, Mass.

Washington-Baltimore Society of Orthodontists

President, Paul W. Hoffman _ _ _ _ _ _ _ _ 1835 Eye St., N. W., Washington, D. C.
Secretary-Treasurer, Stephen C. Hopkins _ _ _ _ _ 1726 Eye St., Washington, D. C.

Foreign Societies†

British Society for the Study of Orthodontics

President, S. A. Riddett
Secretary, R. Cutler
Treasurer, Harold Chapman

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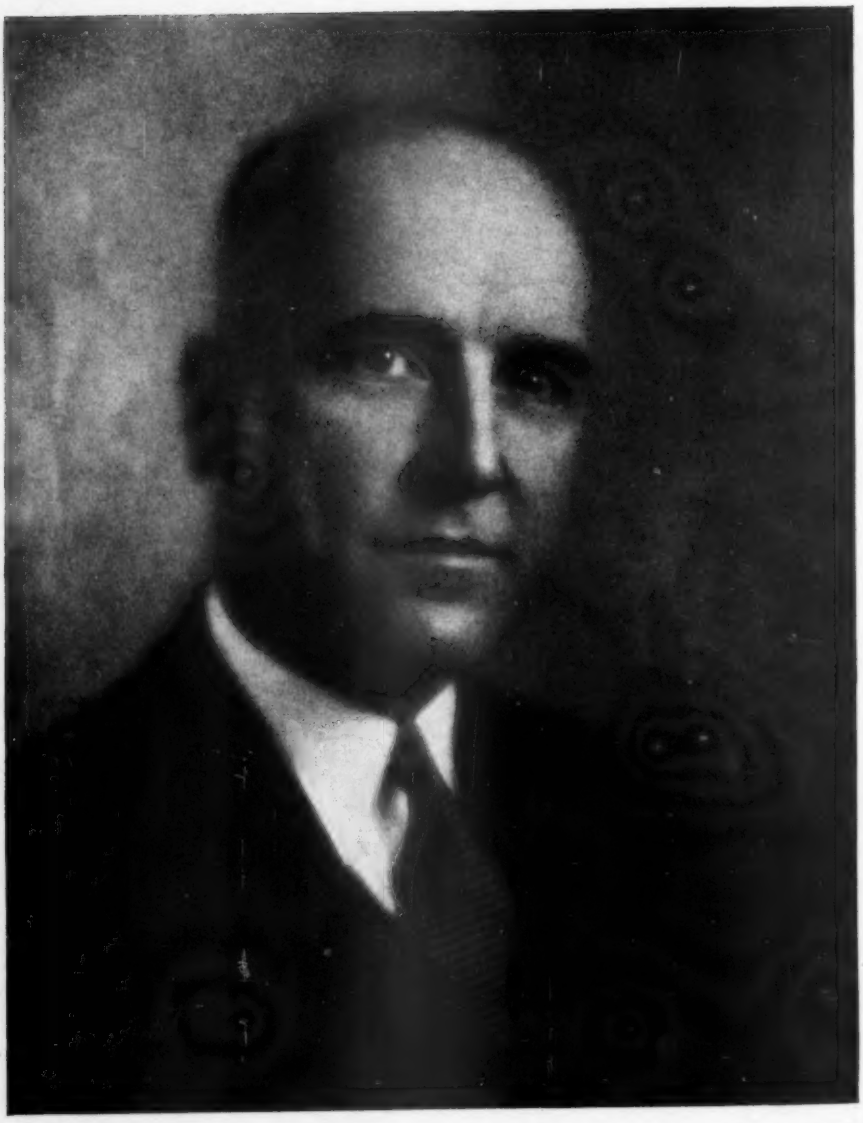
*The Journal will make changes or additions to the above list when notified by the secretary-treasurer of the various societies. In the event societies desire more complete publication of the names of officers, this will be done upon receipt of the names from the secretary-treasurer.

†The Journal will publish the names of the president and secretary-treasurer of foreign orthodontic societies if the information is sent direct to the editor, 8022 Forsythe, St. Louis, Mo., U. S. A.



DR. MAX E. ERNST, SECRETARY OF THE AMERICAN ASSOCIATION OF ORTHODONTISTS.